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Management Plan for Grizzly Bears in Alberta

Alberta

MANAGEMENT PLAN FOR GRIZZLY BEARS

IN ALBERTA

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Appendices to this plan are available upon request.

MANAGEMENT PLAN FOR GRIZZLY BEARS IN ALBERTA
EXECUTIVE SUMMARY

Historical Populations and Management

Although abundant in the varied, open habitats of western North America in the 1700s and early 1800s, grizzly bear populations subsequently declined rapidly in response to unrestricted sport and commercial exploitation. By the late 1800s, numbers of grizzlies were much reduced in "Alberta" and their rarity continued well into this century. Bears were first protected in forest and game reserves in 1927 when permits were necessary to harvest a maximum of one grizzly annually. Classification as "fur-bearing animal" in 1928 and "big game" in 1929 extended protection; however, an open season occurred in southwestern Alberta to reduce predation of livestock. By 1938, grizzlies were reported to be more numerous because of reduced exploitation related to low pelt value. Grizzlies continued to increase and by the late-1940s Government reduced grizzlies in certain forest reserves and game preserves in the southwest. During the 1950s, protection was minimal and populations declined dramatically once again; shooting by landowners, cattlemen and hunters was inadequately regulated and some grizzlies were killed in the anti-rabies poisoning campaign. The 1960s saw a return to greater protection with introduction of a grizzly licence, surveys of hunter harvests, and closure of fall hunting. Populations increased in the 1970s.

Current Status

Grizzly bear population dynamics, food habits or habitat use have been studied in seven locations in Alberta: Swan Hills; Jasper, Banff and Waterton Lakes national parks; Berland-Wildhay; South Wapiti; and Kananaskis Country. An estimated 575 grizzly bears, including a calculated 56 immigrant or transient bears that seasonally use provincial ranges, occur on 154 000 km^2 of provincial lands in Alberta. The total provincial population, including grizzlies in three national parks, is estimated at 790. Primary ranges, where substantial resident grizzly bear populations can be maintained, constitute 78 % of the area. Secondary ranges, which

may be seasonally important to grizzlies, but for which existing land-use activities preclude the support of substantial bear populations, constitute 22%.

Grizzly bears were hunted on a GENERAL (no limit to the number of hunters) season between 1968 when the grizzly bear licence was introduced, and 1988. Annual recreational hunting harvest of grizzlies, averaged within three-year periods, increased from 12 during 1971-73 to 25 during 1978-80; average annual licence sales went from 200 to 850 during this period. During 1979-84, average annual sales rose to 1050 and harvest increased to an average of 42 grizzlies per season. Harvest stabilized during 1982-87 despite continued greater sales of grizzly licences (e.g., 1309 in 1985-86). Harvest of female grizzlies increased during the period of 1979-84.

The number of personal or property damage complaints involving grizzly bears increased throughout the 1970s and 1980s to average 85 per year during 1985-86. The primary basis of complaints during 1980-86 (N = 501) were problematic sightings (39%), killing, mauling or harassment of livestock (21%), human harassment or mauling of humans (17%), park/campground nuisance (5%) and industrial (5%). Four primary concentration areas, Waterton-Crowsnest, Kananaskis-Canmore, headwaters of Red Deer River and Hinton-Cadomin accounted for 62% of total complaints.

During 1974-87, 68 grizzlies were translocated as a result of complaints. Thirty-one (46%) of these were moved from extreme southwestern Alberta. Translocation distances varied from 25 km to 430 km.

Numbers of reported, man-caused grizzly bear mortalities increased from 18 in 1972 to 67 in 1987 with a total of 636 during the 16-year period. Legal hunting harvest was the largest source of mortality at 433 bears (68%). Other sources of known mortality were illegal (13%), problem wildlife (8%), self-defense (6%), Treaty Indian (2%), accidental (2%) and research (1%) kills. Kill sites were disproportionately clumped in BMAs 4A and 4C and in BMA 6 during 1982-86.

The estimated average for total annual man-caused mortality (TKMMs) (68 grizzlies) and the legal harvest (50 grizzlies) exceeded the allowable kill (35 grizzlies) and legal harvest (25 grizzlies) during 1982-86. The provincial grizzly bear population has been overexploited in recent years.

Management Policies, Goals, Objectives and Strategies

1. The provincial grizzly bear population will be increased to 1000. Estimates of populations supportable in specific BMAs and WMUs are provided.

2. Management for viewing and other nonconsumptive enjoyment of grizzly bears will be initiated as a priority in some areas. Complimentary extension activities such as a system of trails and observation sites for viewing of grizzlies and a wildlife outfitting industry for nonconsumptive users will be encouraged.

3. Grizzly bear habitats will be inventoried with BMAs 4A, 4C and 6 as priorities.

4. Additional population inventory is recommended with BMAs 4A, 3A and 6 as priorities.

5. The Division will provide education to resource users and the general public about ecological values of grizzlies.

6. Alberta will coordinate management of shared grizzly populations with neighbouring wildlife agencies.

7. Recreational hunting of grizzly bears will be intensively monitored and harvests reduced. Commencing in 1989, grizzly bears will be hunted only on a limited-entry draw. Harvest will be restricted to 2% of BMA grizzly populations to allow population growth. Once population goals are attained, harvest rate will be 4%. Maximum, man-caused mortality will not exceed 6% in a specific BMA.

8. In historical problem areas, a strategy to minimize bear-cattle conflicts on Crown lands will be initiated through discussions with the appropriate land management agencies and grazing patrons.

9. Divisional policies on problem/nuisance grizzly bear control are outlined. The Response to Dangerous Bears Program and compensation for livestock losses will continue.

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PREFACE

The plan presents the Fish and Wildlife Division's goals, objectives and management strategies for the management of grizzly bears in Alberta, and will be updated periodically and revised as necessary. Implementation will be subject to divisional priorities established during the budget process.

1.0 INTRODUCTION

The grizzly bear (Ursus arctos) represents a great challenge to wildlife management because of its rarity in parts of its North American range, especially south of the 49th parallel (Peek et al. 1987). As humans make more intensive use of grizzly habitats, populations of this large bear often decline. Bear numbers suffer from direct loss or alienation of habitat, from mortalities associated with bear-human conflicts and from increased harvest by hunters using an expanded road system.

In Alberta, as this management plan reveals, grizzly populations increased during the 1970s following major losses during the 1950s and 1960s, when the species was less protected. However, grizzly management in Alberta has not been intensive, and some populations declined again in the 1980s. Remote habitats and protected areas, such as national parks, wilderness areas, and other special areas, continue to provide some security for grizzlies in Alberta. As more intensive use of Alberta's forested areas occurs, however, grizzlies must receive a high level of understanding, tolerance and management if they are to survive in reasonable numbers into the next century.

This management plan details the history of grizzly population fluctuations and their management in Alberta and recommends as a goal a provincial population of 1000 grizzly bears. In determining the current provincial population estimate every effort was made to use the most conservative parameters relating to grizzly numbers. This approach included minimum densities from intensive study areas and the inclusion of 25% more man-caused mortalities to account for unreported cases.

The plan summarizes current uses, and recommends goals, objectives and strategies to ensure the wise use and continued enjoyment of the grizzly resource in Alberta in the years to come.

2.0 BACKGROUND TO THE PLAN

2.1 Historical Populations And Management

The grizzly bear was abundant in the prairie portion of Alberta during early exploration in the 1700s (Burpee 1907, MacGregor 1954, Glover 1962, Nielsen 1975). Nielsen noted that religious taboos and primitive weapons prevented effective hunting by the Natives of the area. David Thompson's journals reported abundant grizzlies near the Bow River in 1787, observations of grizzlies on the Kootenay Plains and "grizzled bears, but not too many" on the Red Deer River. In northwestern Alberta in 1795, Alexander Mackenzie reported grizzlies along the Peace River and the apprehension of the Natives for "this kind of bear." Alexander Henry reported abundant sign of grizzlies along the Baptiste and North Saskatchewan Rivers and recorded 33 grizzly hides in storage at Rocky Mountain House in 1810 (Coues 1897). From these early observations, Nielsen (1975) concluded that during this historical period, grizzlies were common in much of Alberta especially along rivers that supported suitable foods including berries, roots, carcasses of drowned bison and an abundance of other prey species.

During the 1800s, increasing numbers of Europeans with improved firearms became more effective at harvesting grizzly bears. Grizzlies were shot by explorers and fur traders because of the danger the large bear represented (Richardson 1829), for sport (Kane 1925, Spry 1963, Southesk 1969) and because their pelts became more valuable (Innis 1930). By the 1850s, the species was still abundant in certain locales such as the South Saskatchewan River where seven grizzlies were observed during a river crossing by the Palliser Expedition in 1859 (Spry 1963) and along much of the North Saskachewan River (Southesk 1969). Few of these early expeditions passed up the opportunities to hunt grizzlies (Nielsen 1975) and numbers began to decline.

One area in Alberta where grizzlies remained common for a longer period was the Cypress Hills. Natives did not hunt in the hills because of religious taboos. Within a decade of initial, 1871 exploration of the hills by a Hudson's Bay Company trader, Isaac Cowie, other traders and natives quickly decimated the hills' wildlife including grizzlies. Cowie's share of the grizzly kill that first year was 750 skins (Stegner 1962). The

beginnings of settlement, ranching and farming during the 1870s spelled the end of the grizzly bear on the prairies - by the 1880s they were all but gone from that part of Alberta (Nielsen 1975). Sightings of grizzlies in southern Alberta east of the Rockies were considered to be abnormal in the 1890s (McDougall 1898).

At the beginning of the twentieth century, the grizzly bear was scarce in virtually all of the area that ultimately became the province of Alberta (see Nielsen 1975:24). Ranchers routinely destroyed any grizzlies near their cattle herds, as was the case throughout western North America. The development of three mountain national parks - Waterton Lakes, Banff and Jasper - may have afforded some protection to grizzlies during this early period.

Bears were not mentioned in the Game Acts of the Statutes of Alberta, 1907-1927; they were not classified as "big game." Order in Council 946/27 dated 20 August 1927 provided protection to bears for the first time in Forest and Game reserves,

> "3. Permits for hunting or killing of not more than two (2) bear (only one (1) of which shall be a Grizzly) may be issued to residents of the Province on payment of a fee of $5.00 or to non-residents for $25.00. Bear under one year of age or females with cubs at their side must not be killed or taken."

The 1928 Game Act noted bears as a "fur-bearing animal" and established a closed season of 15 June - 1 September. Order in Council 893/28 dated 7 July 1928 noted bears were causing damage to livestock in the Pincher Creek and Cardston Districts and established an

> "OPEN SEASON - on all species of bear, irrespective of sex or age - in that part of the province lying to the south of the Crow's Nest Branch of the Canadian Pacific Railway and to the west of the 5th Meridian (not including any portion of the Waterton Park or the Crow's Nest Forest Reserve)"

The 1929 Game Act classified bears as big game with the same closed season and protection of cubs and females with cubs. Order in Council 362/29 dated 8 April 1929 established the eastern boundary of the "OPEN SEASON" further east to the "Range line between Ranges Twenty-six (26) and Twenty-seven (27), west of the Fourth Meridian."

The 1934 Annual Report of the Department of Agriculture mentions

grizzlies.

> "Bear. - Grizzly bear are not plentiful in the Province, and are very seldom killed. Unfortunately grizzly acquire the habit of killing domestic stock in the southern part of the Province, and special permits are granted for the killing of these animals when they become a menace."

Order in Council 947/35 established an open season for bear between the 2nd of September and the 14th of June. The 1936 Regulations to the Game Act provided a bag limit of "one bear of each species" except in southwestern Alberta as described above, where bears could be killed without "any further licence." The "one bear of each species" bag limit for most of Alberta and their unprotected status in southwestern Alberta remained in effect for a number of years.

Grizzlies were again mentioned in the 1938-39 Annual Report.

> "All kinds of bear may be found throughout the forested regions. Pelts are so low in price, and the difficulties of skinning too great to warrant the effort, and it is evident that even the shy Grizzly is slowly increasing in the quiet fastnesses where it is wont to roam."

Grizzlies continued to be classified as big game through the 1940s. The 1944 Annual Report referred to increasing bear populations

> "Bears have become very numerous in the Province, particularly is this so in connection with the Black Bear. Bears have increased to such an extent as to become a menace to livestock, and numerous complaints have been received throughout the year from livestock owners, telling about the depredation made by Bears. As a consequence, it was found necessary to remove any and all protection from the Black and Brown Bear, and the Grizzly Bear is only protected within the limits of the Forest Reserves. At the present time Black and Brown Bear may be hunted throughout the Province without a licence."

In the late 1940s, Rheinhold Eben, an outfitter and trapper, at Slave Lake estimated 400 grizzlies in the Swan Hills (Nielsen 1975). The Swan Hills population may have been Alberta's greatest regional grizzly population during that period. The 1947 Annual Report noted grizzlies could still be taken without a licence in parts of southwestern Alberta. For the first time, black and brown (black bear) were protected in the Rocky

Mountain Forest Reserve north of the Crow's Nest Pass. The 1948 Annual Report dealt with the unprotected status of grizzlies in southwestern Alberta in more detail and records the apparent hunting of grizzlies by government officers in Forest and Game Reserves

> "Grizzly Bear is still considered to be a predatory animal in some parts of the Province. In the area lying to the south of the Crowsnest-Medicine Hat branch of the Canadian Pacific Railway Grizzly Bear may be shot at any time and without a licence, the reason being that this area is mainly a farming and livestock area and the year-around open season is necessary for the protection of livestock. In addition to this regulation the Department employs special hunters to kill any Grizzly Bear in the Forest Reserves and the Waterton-Carbondale Game Preserves. Black and Brown Bear are still unprotected throughout the Province outside of the Forest Reserves."

McCrory and Herrero (1982) noted numerous cases of ranchers shooting grizzlies in southwestern Alberta during the late 1940s and early 1950s.

During the 1950s, grizzlies continued to be classified as big game; except for southwestern Alberta, where "a licence must be obtained to take a grizzly bear" (1950 Annual Report). Grizzlies received little protection during the 1950s. Many grizzlies were apparently killed in west-central Alberta (Swan Hills, Willmore Wilderness, etc.) during the anti-rabies poisoning program of the 1950s. The Swan Hills area was closed to grizzly hunting during 1958-68.

A Fish and Wildlife Division internal memorandum dated 6 June 1961 attempted to summarize the need for more protection for grizzlies,

> "It would appear that much misunderstanding has arisen regarding bear, due mostly to the fact, that a large segment of the public has attempted to treat bear as a predator rather than a big game animal. This has resulted in many reports being received in this office which would indicate the indiscriminate trapping and killing of bear, particularly grizzly bear. In addition, it has been brought to our attention that in the past some people have made a practice of hunting bear by the use of bait.
>
> In future all applications for permits to destroy bear, for any reason whatsoever, and in particular for alleged damage to livestock, must be fully investigated and permits are only to be issued where absolutely necessary. Further, all permits are to be clearly marked to the effect that the trapping, baiting, snaring, etc., is prohibited. Further, in every case where bear is taken under this type of permit, the skin of the bear shall become the

property of the Crown to be disposed of as the Minister may direct."

The first survey of hunters' harvest of grizzlies in Alberta took place in 1968 and was a joint project of the Department of Rural Economy, University of Alberta and the Fish and Wildlife Division. Wishart and Erickson (1970) estimated the 1968 harvest at 49 grizzlies, including 37 during the fall season. Other surveys were conducted in 1973 (harvest of 20, Parker 1973) and 1981 (socioeconomic analysis, Adamowicz and Phillips 1981, Adamowicz 1983). Compulsory registration of hunters' harvests was initiated in 1971.

Following closure of the fall grizzly hunting season in 1970, total annual mortalities remained below 40 throughout the 1970s. Many hunters, trappers, cattlemen and hikers reported increased signs and observations of grizzlies in western Alberta, especially during the late 1970s and early 1980s (e.g., memorandum L. Veldkamp to J. Gunson, 13 Aug., 1985).

In summary, grizzlies were abundant in southern "Alberta" until at least the 1850s, but were virtually eliminated by 1880. Their rarity in the province continued during the early decades of the 1900s. Protection began in 1927 and numbers were reported to be slowly increasing by the late 1930s. By the late 1940s, they apparently had increased to the point that government personnel hunted them even in the Forest Reserves where they had been protected. Protection was lax during the 1950s when killing of grizzlies was indiscriminate. The 1960s and the 1970s saw a return to greater protection; a grizzly licence was introduced in 1968 and hunting during fall was terminated in 1969-70. Populations increased during the 1970s.

Historical population estimates for grizzly bears in Alberta are provided in Figure 1.

2.2 Biology And Requirements

2.2.1 Distribution

Fossil evidence and historic accounts indicate that grizzly bears occurred throughout most of western North America with concentrations in the Rocky Mountains and major river valleys (Craighead and Craighead 1967,

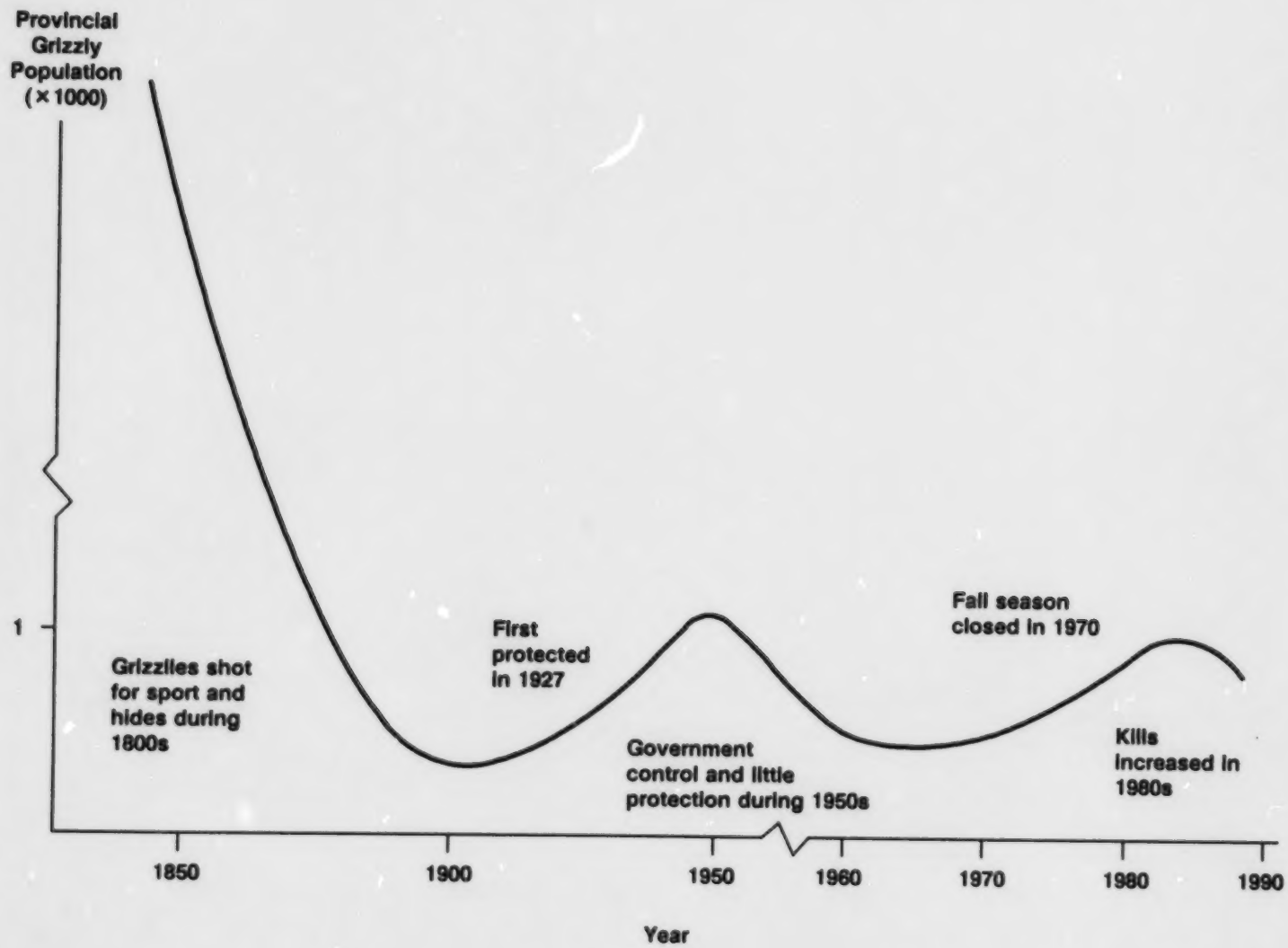

Figure 1. Trends in the grizzly bear population in Alberta.

Banfield 1977, Dood et al. 1986, IGBC 1987). In Canada, grizzlies once occurred on the prairies as far east as the Red River valley, Manitoba, but were exterminated during the early days of exploration and settlement (Nielsen 1975, Banfield 1977). By the 1950s, their range had receded to about three-quarters of that occupied during pre-1900 times (IGBC 1987). Currently in Canada, self-sustaining populations occur in undeveloped and wilderness areas of Alberta, British Columbia, Northwest Territories, and Yukon Territory, with the greatest numbers occurring in the Yukon and British Columbia (Herrero 1985, Peek et al. 1987).

2.2.2 Description

2.2.2.1 Body Weights

The grizzly bear is the second largest member of the bear family, Ursidae. Sexual dimorphism occurs, with mature males attaining sizes twice that of mature females (Kingsley et al. 1983). In southwestern Alberta, average weights of subadult and adult (≥6 years) females were 90 kg and 111 kg, respectively, while those for males were 139 kg and 177 kg, respectively (Carr 1989). In Jasper National Park (Russell et al. 1979) and west-central Alberta (Nagy et al. unpubl. data), spring weights of adult males average 200 kg, while females average 90 kg and 150 kg, for subadults and adults, respectively. Average fall weights of adult male and female bears in Jasper were 50% and 85% greater, respectively, than those in spring. Fall weights of grizzlies in the South Wapiti area and Jasper were similar (Horejsi and Raine 1983). Similarly, the maximum weights recorded for adult males and females in Swan Hills were 218 kg and 206 kg, respectively, while average weights were 218 kg (n=1) and 178 kg (n=3), respectively (Nagy and Russell 1978). Although Oeming reported greater average mature weights for grizzly bears in Swan Hills (AWA and NPPAC 1976), weight and morphometric data suggested that they were similar in stature to those in other regions of Canada (Nagy and Russell 1978). Grizzly bears in Swan Hills should not be considered unique in comparison with other populations in Alberta.

2.2.2.2 Seasonal Weight Change

Grizzly bears undergo tremendous seasonal changes in body weight (Kingsley et al. 1983). Following emergence in the spring, little or no gain in body weight may occur until late July or August; however, from mid-July through September weight gains are substantial (Craighead and Mitchell 1982, Nagy and Russell 1978). Summer-to-fall weight gains ranged from 110% for cubs (Troyer and Hensel 1969), 30% to 100% for subadults, and 6% to 98% for adults (Blanchard 1987, Troyer and Hensel 1969, Nagy et al. 1983a,b). Rates of gain may be dependent on season, availability of various food items, and feeding habits and reproductive status of individual bears (Nagy et al. 1983b).

Females and males gained weight at rates of 0.28 (0.0 to 0.48) and 0.39 (0.13 to 0.68) kg/day in Swan Hills (Nagy and Russell 1978). The greatest change in body weight was a 91% increase over 120 days for an adult female and a 330% increase over 140 days for a subadult male. Bears gained most weight during the period when they were feeding on berries. Similarly, in Jasper National Park, the average daily weight gain during the active period was 0.215 kg (n=2) (Russell et al. 1979). Garbage-fed bears were heavier than their counterparts that did not feed on garbage.

Weight losses during winter hibernation are variable. Bears in Yellowstone lose between 8% and 18% of their fall weights during denning (Blanchard 1987). In comparison, bears in northern Canada lose an average of between 24% and 43% of their fall weights at rates of between 0.02 and 0.22 kg/day (Pearson 1975, Nagy et al. 1983a,b). In Jasper National Park, the average weight loss during winter hibernation was 0.22 kg/day (n=3) (Russell et al. 1979). These significant weight losses during hibernation emphasize the importance of fall conditioning for winter survival of grizzly bears.

2.2.2.3 Pelage Color

Grizzly bears are variable in color. Most northern and western Alberta grizzly bears are brown (Nagy and Russell 1978, Russell et al. 1979). The remainder may have brown underfur with black, blonde, yellow, or silver-tipped guard hairs on their sides, back, neck and head. The humps may be

darker than the torso and the legs brown to black (Nagy and Russell 1978, Russell et al. 1979).

B.2.d Sensory Acuity

Bears have well-developed olfactory and auditory systems, and can visually recognize objects at distances of up to 60 m (IGBC 1987). Although smell is their best developed sense, foraging, feeding, and predatory behaviors are thought to be facilitated by an integration of all sensory systems (IGBC 1987).

2.2.3 Social Organization

Grizzly bears are solitary animals, with groups of three or four usually consisting of a sow with cubs, yearlings, or subadults. Male-female associations generally occur only during the May-July breeding season. Grizzly bears generally show a low degree of social organization, but may form loose social aggregations at sites of plentiful food such as garbage dumps or salmon streams. At these sites, grizzly bears assume behavior that is characteristic of more gregarious species (IGBC 1987).

2.2.4 Reproductive Biology

2.2.4.1 Breeding Season

Courtship associations have been observed in North America as early as the last week in April and as late as early August (IGBC 1987). The breeding season in Alberta occurs during May through mid-July (Herrero and Hamer 1977, Nagy and Russell 1978, Russell et al. 1979, Hamer et al. 1980, Nagy et al. 1989).

2.2.4.2 Breeding Ages

The youngest age of sexual maturity for female grizzly bears in North America is 3.5 to 4.5 years (Craighead et al. 1969, Hensel et al. 1969, Glenn et al. 1976, Nagy and Russell 1978, Nagy et al. 1983b); however, most

do not successfully conceive until age 6.5 years (range 5.5 to 9.5 years) (Craighead et al. 1969, Pearson 1975, Glenn et al. 1976, Russell et al. 1979, Reynolds 1980, Miller et al. 1982, Nagy et al. 1983a,b, Nagy et al. 1989). Maximum ages of sexual activity range from 18.5 to 24.5 years (Craighead et al. 1969, Pearson 1975, Nagy and Russell 1978, Nagy et al. 1983a,b).

In Alberta, female grizzly bears successfully bred at ages 3.5 to 19.5 years in Swan Hills (Nagy and Russell 1978). The early age of sexual maturity for some young females may have been due to their use of high energy foods at the town garbage dump. In Jasper National Park, the minimum age of first parturition was five years (range five to seven years, Russell et al. 1979), while the youngest and oldest ages of known parturition among females in the Berland-Wildhay River area were 6 and 16 years, respectively (Nagy et al. 1989).

2.2.4.3 Litter Size

The cubs, born in January or early February, are blind and hairless and weigh about 0.5 kg. Mean litter sizes for grizzly bear populations in North America range between 1.6 and 2.5 young (Mundy and Flook 1970, Martinka 1974, Pearson 1975, Glenn et al. 1976, Reynolds 1976, Russell et al. 1979, Reynolds 1980, Craighead and Mitchell 1982, Miller et al. 1982, Nagy et al. 1983a,b, McLellan 1984, Nagy et al. 1989). Mean litter sizes were 2.2 young (n=5) in Swan Hills (Nagy and Russell 1978), 2.0 young (n=3) in Jasper National Park (Russell et al. 1979), and 1.6 young (n=7) in the Berland-Wildhay area (Nagy et al. 1989). The small litter sizes observed in the Berland-Wildhay area were considered to be a result of declining habitat quality.

2.2.4.4 Reproductive Interval

Female grizzly bears produce young every two to five years in North America (Mundy and Flook 1970, Martinka 1974, Pearson 1975, Glenn et al. 1976, Reynolds 1976, Russell et al. 1979, Reynolds 1980, Craighead and Mitchell 1982, Miller et al. 1982, Nagy et al. 1983a,b, McLellan 1984, Nagy et al. 1989). The reproductive interval for grizzly bears was observed to

be three years in Swan Hills (Nagy and Russell 1978) and estimated to be ≥4 years in west-central (Berland-Wildhay) Alberta (Nagy et al. 1989).

2.2.5 Natural Mortality

Mortalities among subadult bears are caused by malnutrition, predation, and natural or man-caused accidents (Nagy et al. 1983b, Knight et al. 1985). Mortalities of grizzly bears through predation are almost exclusively attributable to conspecifics, usually large males (Archibald 1983). The frequency of intraspecific predation may be a function of population density or availability of habitat (Mundy and Flook 1973).

Mortality rates are highest among cubs, with losses of entire litters being common (Reynolds and Hechtel 1982, Nagy et al. 1983a,b). Nutrition-related deaths become almost negligible in adults, although mortalities may occur among reproducing females in areas or periods of low habitat productivity (IGBC 1987). In addition, accidental deaths resulting from natural or man-caused factors have been recorded for all age classes of bears (Russell et al. 1979, Nagy et al. 1983b, Gunson and Treichel 1987).

Annual mortalities among cubs of the year were as high as 75% in northern Canada, with that rate dropping to 25% once the young pass their second year of life (Nagy et al. 1983b). Total natural mortality for grizzlies in their first 3 years has been estimated at 21% in southern Yukon (Pearson 1975) and 74% in northern Alaska (Reynolds and Hechtel 1982), while that for bears ≤6 years was estimated at 62%-77% in Yellowstone National Park (Knight and Eberhardt 1984) and 65% in northern Yukon (Nagy unpubl. data). These data suggest that natural mortality is a significant factor affecting grizzly bear numbers.

2.2.6 Population Densities

Unhunted populations in areas of favorable habitat occur at densities ranging from 23 to 44 bears/1000 km^2 in the Northwest Territories, Yukon Territory and Alaska (Pearson 1975, Dean 1976, Reynolds 1980, Nagy et al. 1983a) and 35 to 55 bears/1000 km^2 in British Columbia and Montana (Mundy and Flook 1973, Martinka 1974). In comparison, density levels of 4 to 11 bears/1000 km^2 have been reported for hunted populations in Alaska,

Northwest Territories, and Alberta (Reynolds 1976, Nagy and Russell 1978, Miller et al. 1982, Nagy et al. 1983b, Nagy et al. 1989) and 10 to 12 bears/1000 km^2 for unhunted grizzly bears occupying areas of declining habitat in Alberta (Russell et al. 1979).

The effect of overharvest on bear densities is illustrated by comparing values for hunted and unhunted populations occupying similar ecosystems in eastern Brooks Range, Alaska (Reynolds 1976) and northern Yukon (Nagy et al. 1983a). Densities of bears for the Alaskan population, which had been hunted for 15 years, were one-quarter to one-seventh of those reported for the unhunted northern Yukon bears.

2.2.7 Home Range Size

In North America, the size of grizzly bear home ranges varies with sex, age, and reproductive status of animals within and among populations (Pearson 1975, Craighead 1976, Reynolds 1976, Nagy and Russell 1978, Russell et al. 1979, Reynolds and Hechtel 1980, Nagy et al. 1983a,b, IGBC 1987, Nagy et al. in prep). Home range size is also influenced by population density (Sanderson 1966) and habitat quality (Slade and Swihart 1983).

In Jasper National Park, Alberta, mean annual home ranges were 210 km^2 for subadult females, and 217 km^2 and 644 km^2, for adult females and males, respectively (Russell et al. 1979). In Swan Hills, annual home ranges varied in size from 113 km^2 to 244 km^2 for subadult and adult females, respectively, and 82 km^2 to 1086 km^2 for subadult and adult males, respectively (Nagy and Russell 1978). Similarly, in the Berland-Wildhay area, average home range sizes for different classes of females ranged from 252 km^2 to 502 km^2, while those for males ranged from 1918 km^2 to 2755 km^2 (Nagy et al. in prep.). The sizes of home ranges in the Berland-Wildhay area were among the largest reported for grizzly bears in North America, a possible consequence of the mature conifer, poor-quality habitat with low availability of preferred foods.

2.2.8 Seasonal Movements

Movements of bears are influenced by the juxtaposition or availability of seasonally important food resources or habitat components, breeding

activity, reproductive status of individuals, and availability of denning habitat (Glenn 1976, Nagy and Russell 1978, Russell et al. 1979, Reynolds 1980, Hamer et al. 1983, Nagy et al. in prep). Long-range movements of 50 km to 150 km between seasonal ranges have been reported (Berns and Hensel 1972, Craighead and Craighead 1972a,b, Russell et al. 1979).

Sows with cubs inhabit areas of rugged terrain, presumably for security, while males more frequently occupy valley bottoms and travel on well-used trails (Pearson 1975, Russell et al. 1979, Nagy et al. 1983a). Adult females and subadults reside in areas of higher elevation and travel the lightly used trails. Adult males may be a threat to the survival of subadults (Russell et al. 1979).

2.2.9 Dispersal

In most grizzly bear populations, the maternal bond between a female and her young is broken when the female comes into estrus at the same time that the young bears are 2.5 to 3.5 years old (Pearson 1975, Nagy et al. 1983a,b, Nagy et al. 1989). The pattern of dispersal following "weaning" differs for males and females. Subadult males generally disperse large distances out of the maternal range (Glenn 1976, Craighead and Mitchell 1982, Nagy et al. 1983b, Knight et al. 1984), with establishment of a home range dependent on availability of social space or suitable habitat (Russell et al. 1979, IGBC 1987).

Subadult females usually establish their home range within or adjacent to the maternal range (Pearson 1975, Nagy et al. 1983b, Nagy et al. in prep.). Adult females most likely produce their female replacements, or produce females that stock vacant, adjacent home ranges. Long-range dispersals of subadult females have not been reported in the literature, and as a result, recolonization by females of areas in which breeding populations have been depleted would be slow (Barrett et al. 1987).

2.2.10 Denning

The general ecology of grizzly bear den sites is similar in most geographic areas, despite differences resulting from local biogeoclimatic factors (Vroom et al. 1980). Dens are excavated in slopes featuring

orientation aspects that vary from region to region, but which generally are oriented to ensure a good early catchment of insulative snow cover over the den entrance. The angle of slope on which dens were excavated ranged in most regions from about 22° to 45° (Lentfer et al. 1972, Vroom et al. 1980, Russell et al. 1979, Pearson 1975, Nagy et al. 1983a,b). Sloped sites are selected undoubtedly for ease of digging. The slope surface is generally stabilized by root systems of herbaceous vegetation and trees or boulders. Dens are rarely used more than one winter.

Grizzly bears prepare dens well in advance of hibernation (Craighead and Craighead 1972b). Denning dates vary from region to region, and from year to year within a region, but initiation of denning usually occurs during late October and November (Craighead and Craighead 1972b, Pearson 1975, Russell et al. 1979, Reynolds 1980, Nagy et al. 1983a,b, Barrett et al. in prep.). Lone females and females with young enter their dens before subadult and adult males (Barrett et al. in prep.).

Grizzly bears emerge from winter dens as early as mid-to late April in Banff National Park (Hamer et al. 1979, Hamer and Herrero 1983). Russell et al. (1979) found that males emerged early in April, while most females did not leave dens until mid-April to early May in Jasper National Park. A similar pattern of spring emergence was observed in west-central Alberta (Barrett et al. in prep.).

2.2.11 Habitat Use

Grizzly bears are generally considered to require wilderness habitats with a minimum of use by humans (Craighead 1976). Most major habitats are used by grizzlies because they eat a wide variety of foods (Section 2.2.12 following, Food Habits), and also require denning, resting and mating areas, along with escape terrain for avoiding humans and predaceous boars. Mace (1986) divided his study area in the Bob Marshall Wilderness, Montana into eight grizzly habitat components, namely, flood plain complex, avalanche chute, timbered creek bottom, burn shrubfield, mountain sidehill park, slabrock, subalpine meadow and alpine complex. Grizzly habitat use patterns closely follow the seasonal variations in quantity and quality of important foods as observed in Denali National Park, Alaska (Stemlock 1981), Jasper National Park, Alberta (Russell et al. 1979) and Banff National Park,

Alberta (Hamer and Herrero 1983). Hamer and Herrero pointed out that variations in mating behavior, human activities, chance events and weather confound prediction of habitat use. In Kananaskis Country, Alberta, most preferred habitats of grizzlies were fire-successional, early seral types, such as young and open lodgepole pine forest and shrubfields (Wielgus 1986). In the latter area, differences in habitat use between sexes was noted. In early summer, females concentrated on higher elevation, early seral types with Hedysarum, while males shifted to old growth spruce and pine forests to hunt ungulate calves and feed on emerging Equisetum.

Primary encroachments on grizzly bear habitat in Alberta are related to agricultural and industrial development. IGBC (1987) identified the primary impacts of agriculture as the following:

1. Direct loss: mortality or loss of grizzly bears through control actions, relocations, and illegal kills associated with grazing leases, ranching or farming operations.
2. Indirect loss: habituation of grizzly bears to human activity following attraction to livestock, livestock carrion, crops, etc., predisposing them to nuisance behavior elsewhere.
3. Habitat loss or modification as a result of grazing or other agricultural activity.
4. Displacement (temporally or spatially) away from agricultural activity.
5. Direct competition with livestock for preferred foraging species.

IGBC (1987) identified potential impacts, common to hydrocarbon exploration and development and hydroelectric development, as follows:

1. Construction or upgrading of roads which provide increased access into grizzly bear habitat and consequent escalation of human activities (e.g., hunting, hiking, camping) in both frontcountry and backcountry areas.
2. Increased human activity related directly to project construction or maintenance.
3. Increased availability of artificial attractants (especially garbage) and possibly increased legal and illegal grizzly bear

mortality as a result of 1. and 2.

4. Possible displacement or disruption of normal behavior patterns (including denning, movements, and habitat use) because of increased human activity, construction, operation of industrial equipment, or habitat modification.
5. Direct habitat loss as a result of road construction, buildings, etc., or, with regards to hydroelectric development, more extensive habitat loss from impoundments.
6. Increased aircraft disturbance.
7. Physiological disturbance/arousal not accompanied by overt behavioral response.

2.2.12 Food Habits

Grizzly bears are able to use a wide variety of foods, and range from an almost totally vegetarian diet to a heavy dependence on animal protein (Nagy et al. 1983b, IGBC 1987). Although the species of plants and animals consumed vary, the general foraging regime for most interior grizzly bear populations appears to be similar (Pearson 1975, Reynolds 1976, Hamer et al. 1977, Russell et al. 1979, Reynolds 1980, Hamer and Herrero 1983, Nagy et al. 1983a,b, Servheen 1983, Nagy et al. 1990).

The roots of Hedysarum spp. were important spring, late summer, and autumn food items in Banff, Jasper, and Waterton Lakes national parks (Hamer and Herrero 1983, Russell et al. 1979, Hamer et al. 1978), and in west-central Alberta (Nagy et al. in prep.). Overwintered berries of bearberry (Arctostaphylos spp.) or grouseberry (Vaccinium spp.) were consumed during spring in most areas and could be a desired food source because of their high sugar content (Hamer et al. 1978). As green-up occurs, bears shift their foraging activities to grasses, sedges (Carex spp.), horsetails (Equisetum), and various forbs (Heracleum, Valeriana, Rumex). Non-native forbs such as alsike clover (Trifolium hybridum) and red clover (Trifolium pratense) are used extensively throughout the year where available (Nagy and Russell 1978, Nagy et al. 1990). In late summer and fall, bears concentrate their foraging activities on berries including buffalo-berry (Shepherdia spp.), blueberries (Vaccinium spp.), and bearberry. During years of poor berry production grizzly bears will use roots of Hedysarum and the corms and

bulbs of various plant species during late summer and fall. Grizzly bears feed opportunistically on carrion, or prey on large mammals such as elk (Cervus elaphus) and moose (Alces alces) and small mammals including ground squirrels (Spermophilus spp.) or other rodents. Ants, bumblebees, and various larvae are eaten.

In the Swan Hills (Nagy and Russell 1978) the food habits of grizzly bears differed markedly from those in other areas of Alberta in that roots, bulbs, and small mammals were absent from their diets. In addition no evidence was found of predation on ungulates.

Grizzly bears are known to use winter-killed and weakened ungulates or ungulate neonates in many areas (Mattson and Henry 1987). In Banff National Park, grizzly bears hunted elk calves in late May and early June, and scavenged and possibly killed adult male elk during the elk's September mating season (Hamer and Herrero 1987a). Similarly, in Jasper National Park, ungulate remains identified in June faeces suggested that bears were either feeding on winter-killed animals or were preying on weakened or newborn ungulates (Russell et al. 1979).

Grizzly bears are primarily herbivorous in their diets; the major food items characteristically occur in early seral plant communities where forest cover is absent or understocked (Hamer and Herrero 1983, 1987a, b). In Banff National Park, where wildfires have been absent since 1936 (49 years), forest encroachment has been occurring on seasonally important grizzly bear foraging habitats (Hamer and Herrero 1983). Where post-fire vegetation has succeeded to well-stocked forest stands, the sites have been generally unused by grizzly bears as feeding sites.

Zager et al. (1983) argued that wildfires in their northwestern Montana study area benefited grizzly bears by removing the forest canopy and creating fruit-producing shrubfields. In normal years, areas recently burned by wildfire were expected to produce more fruit than forested communities or old burns (Martin 1983).

Wildfires have been suppressed under progressively intensive forest management practices in much of Alberta since the 1930s (Murphy 1985), and many productive forests have advanced to mature or overmature age-classes (Rose 1981). Because the plant communities in grizzly bear feeding habitat often appear to succeed to forest types determined to be unimportant to foraging bears (Hamer and Herrero 1987b), the abundance of grizzly bear

feeding habitats may have decreased in the absence of wildfires in much of western Alberta. If this is the case, declines in grizzly bear densities can be expected (Hamer and Herrero 1987b).

The food habit data reported for bears in Swan Hills and west-central Alberta indicated that grizzlies used areas of improved habitat resulting from oil and gas exploration and development activities (Nagy and Russell 1978, Nagy et al. 1990). Typically in Alberta, exploration roads and pipeline rights-of-way are seeded with a mixture of grasses and alsike or red clover. The resulting areas of luxuriant plant growth transect homogeneous natural stands of forest cover and benefit bears from a nutritional standpoint, particularly where natural vegetation has advanced to less productive seral stages (Nagy and Russell 1978, Nagy et al. 1989). However, bears are attracted to these areas along roads and around wellsites where they are more susceptible to hunting. Use of clover on a site-specific basis has obvious advantages in improving habitat for bears, but should be avoided near sites of intensive recreational activity or industrial development to reduce the potential for bear-man encounters.

2.2.13 Diseases and Parasites

Grizzly bears are susceptible to rangiferine brucellosis and *Brucella susis*-type 4 (IGBC 1987). Rangiferine brucellosis is suspected to affect reproduction negatively in grizzly bears. Leptospirosis was reported in Alaskan grizzlies. Other infectious and noninfectious diseases reported to occur include the following: clostridium, toxoplasmosis, canine distemper, rabies neoplasms, and hypothyrodism. The prevalence and effects, if any, of these diseases on natural populations is unknown (IGBC 1987).

Trichinella infestations occur in up to 50% of bears within study populations in North America, and is maintained through cannibalism and scavenging (IGBC 1987). The prevalence of *Trichinella* among grizzly bears in Alberta has increased in recent years to 33% of bears tested (Dies and Gunson 1984, B. Treichel and J. Gunson, 1987 unpubl. memos.).

Encysted *T. spiralis* have been found in consistently high concentrations in the tongue, masseter, diaphragm, and femoral muscles of grizzlies, and at such levels could affect the nervous system and possibly cause abnormal behavior in bears (IGBC 1987). Larval densities in grizzly bears

may surpass those considered lethal to humans, and as a result Trichinella is a primary public health and bear management concern (IGBC 1987).

2.3 Status

2.3.1 Distribution and Populations

The distribution and relative abundance of grizzly bears based on known locations of kills and personal/property damage complaints is shown in Figure 2. The primary range of grizzly bears in Alberta includes montane, subalpine, and alpine habitat regions in and adjacent to the Rocky Mountains in the west, and in boreal mixed-wood, boreal foothills and boreal upland habitat regions in west-central Alberta. The largest contiguous block of habitat occurs in west and west-central Alberta, extending from the British Columbia border east to include the area from Jasper National Park-Willmore Wilderness north and northeast to Grande Prairie, Swan Hills and Edson. Their distribution is discontinuous in the boreal mixed-wood and boreal upland habitats in the Peace River-Grande Prairie area and in the aspen parkland in southern and central regions of the province. Little is known of their distribution in the boreal subarctic regions of northwestern Alberta.

Studies of grizzly bear population dynamics, food habits, or habitat use have been investigated at seven locations in Alberta (Figure 3). The primary emphasis of each study is outlined below, particularly focusing on summarizing data pertaining to population characteristics.

2.3.1.1 Swan Hills (Nagy and Russell 1978)

Nine male and nine female grizzly bears were captured during 1975-1977. Bear densities based on enumerated and estimated population numbers ranged from 7.4 to 9.6 bears/1000 km^2, respectively. The population was extremely young having a large number of subadults and few adults. The ratio of subadult to adults for captured bears was 13:5, while that for bears which were killed was 18:2. This suggested that the area may act as a population sink for subadult grizzlies dispersing from surrounding areas.

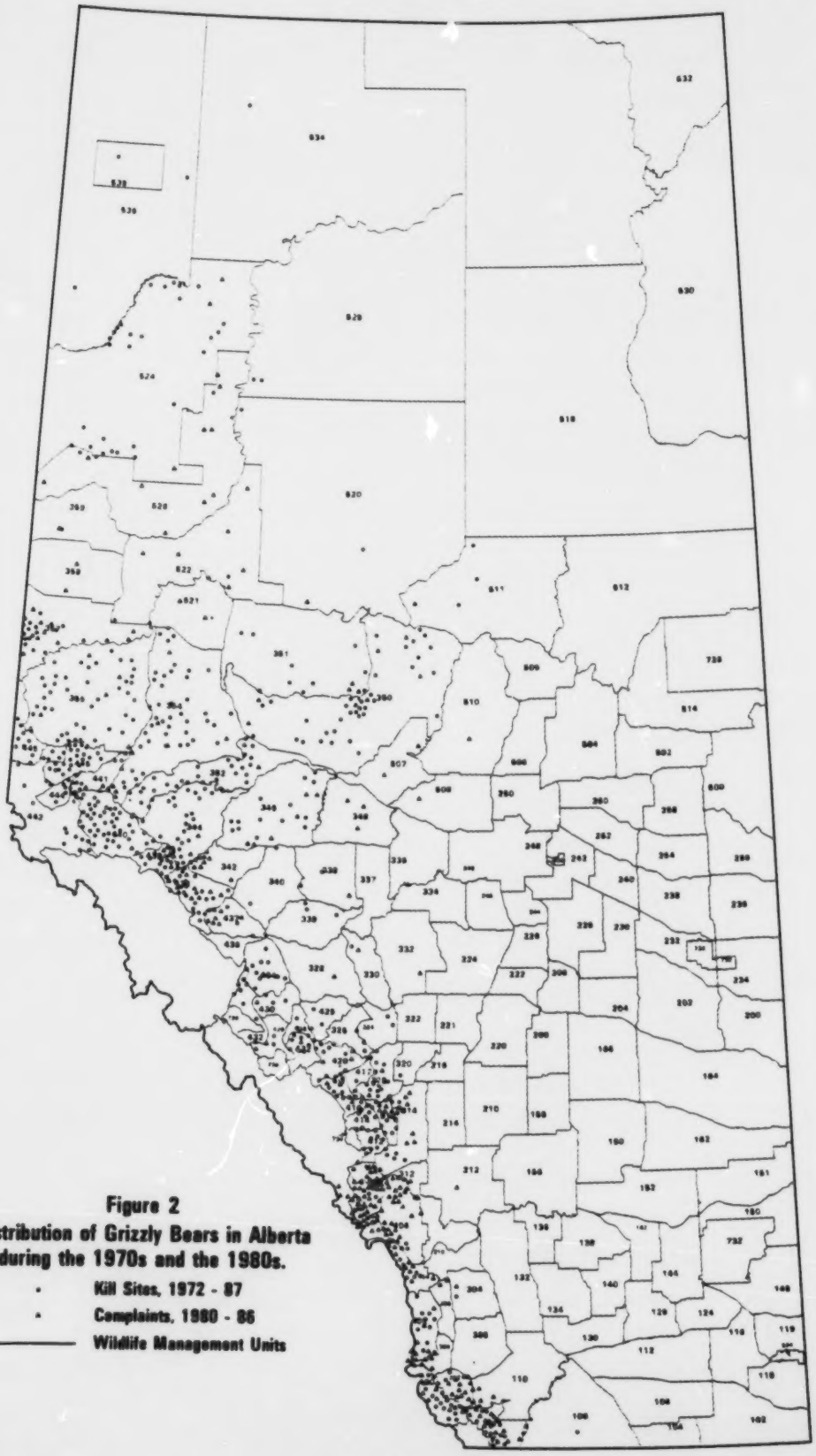

Figure 2
Distribution of Grizzly Bears in Alberta during the 1970s and the 1980s.

- Kill Sites, 1972 - 87
- Complaints, 1980 - 86
- Wildlife Management Units

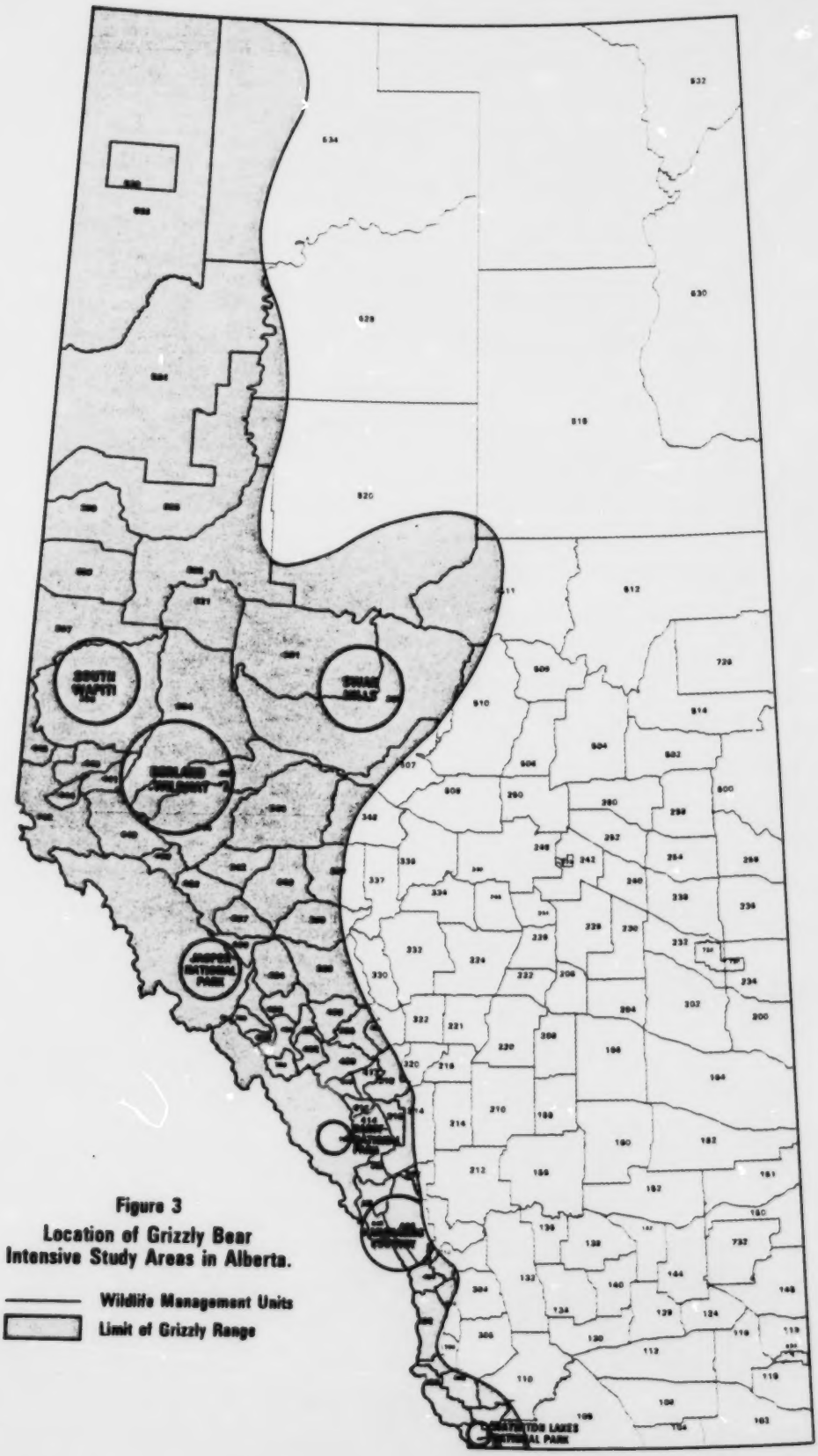

Figure 3
Location of Grizzly Bear Intensive Study Areas in Alberta.

Wildlife Management Units

Limit of Grizzly Range

This age ratio characteristic of the grizzly bear population was considered to be a result of the impacts of past and present development activities. It was felt that a large number of resident grizzlies had either been displaced or killed during early phases of development. Twenty grizzly bears were removed from the population during 1972-77. Mortality records indicated that 1) the average age of bears removed was around 2.5 years (age of self-sufficiency), 2) both males and females were removed, 3) and relocation or destruction of nuisance bears was a significant mortality factor. Effective recruitment to the resident population was considered to be low because of the removal of subadult males and females. The grizzly bear population was considered to be in a state of decline.

2.3.1.2 Jasper National Park (Russell et al. 1979)

Twenty-four grizzly bears were captured or observed during 1975-1978. Densities were estimated to range between 9.8 and 11.7 bears/1000 km^2. The total population for the park was estimated at 105-125 bears. The Warden Service suggested that grizzly bear numbers had declined in the park during the last 30-40 years as a result of a reduction in major fires and because of factors negatively affecting the availability of carrion and prey species.

The population had a stable age distribution with balanced distribution of sexes in adult and subadult age classes. The estimated subadult ($\leq$6 years) to adult ratio was 6:10, while the sex ratio was 14 males:6 females. The preponderance of males in the capture group was possibly due to the presence of far-ranging males that occupied spring and autumn ranges in the park where trapping was concentrated. Sex ratio of resident bears was 7 males:6 females.

Eight of 24 marked bears died during 1975-78 giving an estimated annual mortality rate of 14.9 percent. Three of those eight were legally harvested outside of the park boundary near the Brazeau and Southesk rivers.

2.3.1.3 Banff National Park (Hamer et al. 1977, 1979, Hamer and Herrero 1983, 1987a, 1987b)

Grizzly bear seasonal food habits and habitat use were studied during

1976-1980 in the Front Ranges of Banff National Park, Alberta. The study area included the Cuthead Creek drainage, the headwaters of Wigmore Creek, and the Cascade Valley from Cuthead Creek to the elk trap located 5 km downstream from the Cuthead/Cascade confluence. Detailed vegetation analysis and fire history studies formed the basis for interpreting food habits and habitat use as determined by scat analysis and radiotelemetry of adult female grizzly bears.

2.3.1.4 Waterton Lakes National Park

Hamer et al. (1985) obtained food habit, habitat use, and home range data by intensively monitoring two radio-collared female grizzly bears in Waterton Lakes National Park.

De Boon (1986) reviewed sighting reports and estimated that between 35 and 48 bears used the park seasonally, at densities of 67 to 91 bears/1000 km^2. These density values are significantly greater than that of 47 bears/1000 km^2 reported for Glacier National Park, Montana (Martinka 1974). K. Brady (Waterton Park warden, pers. comm. 1988) indicated that a realistic population estimate for the park is 25 resident bears (48 bears/1000 km^2), with many of those bears using areas outside of the park to meet their seasonal habitat requirements (R. Watt and A. Sturco, pers. comm. 1988). K. Brady suggested that an abnormally large number of transient bears used the park seasonally during the last five to six years because of a series of successive failures in the berry crop along the continental divide.

2.3.1.5 Berland-Wildhay (Nagy et al. 1989)

Eighteen male and 20 female grizzly bears were captured during 1981-84. The average post-emergence spring population actually counted was 37 animals, yielding an estimated density of 4.6 bears/1000 km^2. The grizzly bear population was characterized by poor productivity (1.8 cubs/female and a reproductive interval of >4 years). The estimated annual mortality rate within a 19 753 km^2 area surrounding the study area ranged from 6% in 1981 to 19% in 1984. Legal harvest alone accounted for average annual losses of 7% (range 0% in 1981 to 15% in 1984). Of those bears harvested, 75% were taken within 1 km of an all-weather road. Annual mortality rates based on

known legal sport kills of marked bears recorded during the study were between 5% and 8% for 1981-83, and estimated rates of 14% and 19% for 1984 and 1985, respectively. These data collectively suggest that the bear population was declining. This decline was considered a reflection of the effects on that population of long-term legal harvest, encroachment of resource development activities, and habitat deterioration.

2.3.1.6 South Wapiti (Horejsi and Raine 1983, Horejsi 1986)

Thirty-five grizzly bears were captured during 1980-84. In four years, eight of the 35 bears captured had been killed, and two others were unaccounted for, representing a minimum estimated annual mortality rate of 6%. Fifty percent of the females four years of age or older died, giving an annual mortality rate of 11%. The density of bears in this area was estimated at 7.4 bears/1000 km^2 (F. Harper, B.C. Wildlife, pers. comm.).

2.3.1.7 Kananaskis Country and area (Carr 1989)

Twenty-five grizzly bears were captured during 1980-84. The sex ratio of captured bears was 3.3 males:1 female. Age structure evaluation indicated adult (6+ years):subadult (3-5 years) ratios of 1.25:1 for males and 2.75:1 for females. The density of bears in this area was estimated at 12.2 to 14.5 bears/1000 km^2.

Average annual, known man-caused mortality of marked bears was 7%-8%. Six bears were legally harvested, three were self-defense actions, and one a research mortality. Forty-five percent of the marked males and 17% of the marked females were removed during eight years.

2.3.2 Management

2.3.2.1 Bear Management Areas

Grizzly bears have not been uniformly exploited, either spatially or temporally, throughout Alberta. However, the population characteristics, current status, and future management of grizzly bear populations should reflect or benefit from the knowledge of those regional differences in

historical exploitation (total known man-caused mortalities). Therefore, Wildlife Management Units (WMUs) were pooled within existing Big Game Zones (BGZs) to form larger land units in which the dynamics of grizzly bear populations were expected to be influenced by common sources (Harris 1984). This was accomplished by first calculating an average kill density (number of bears killed/year/1000 km^2) for each WMU for the period 1972-87. WMUs with similar kill densities, phytogeographic characteristics, land use practices, and degree of development were grouped to form Bear Management Areas (BMAs) (Figure 4) within existing BGZs. Mortalities, translocations, and personal/property damage complaint data, were analyzed on a BMA basis to identify regional trends in numbers of grizzly bears.

2.3.2.2 Hunting Management

2.3.2.2.1 Licences - Licence sales increased from 200-350 annually in the late 1960s to 1000-1300 in the 1980s (Table 1, Figure 5). Although the number of licences sold to nonresidents increased from an average of 3%-5% of the annual total during 1971-83 to 13% in 1986, the greatest proportion of all licences (87%-100%) were sold to resident hunters (Table 1).

2.3.2.2.2 Harvest Success - Successful hunters in Alberta have been required to submit skulls and hides of grizzly bears for inspection as part of a mandatory registration system since 1971.

The average harvest success rate for resident hunters was 3% during the period 1971-87, but ranged from 3%-7% during 1971-77, decreased to 2% during 1978-79, and has remained at 3%-4% since 1980 (Table 1). The average success rate for nonresident hunters was 12%, but ranged from 0%-35% (Table 1). Harvest success rates based on three-year running averages indicate that resident success rates have remained at around 3%-4% since 1975-77, while those for nonresidents have declined since 1976-78 (Table 1).

Nonresidents killed 11%-18% of the bears harvested annually during 1975-77, 26%-33% during 1978-79, 9%-17% during 1980-83, and 23%-33% during 1984-86 (Table 1). On average 20% of the bears harvested annually since 1981 were killed by nonresident hunters.

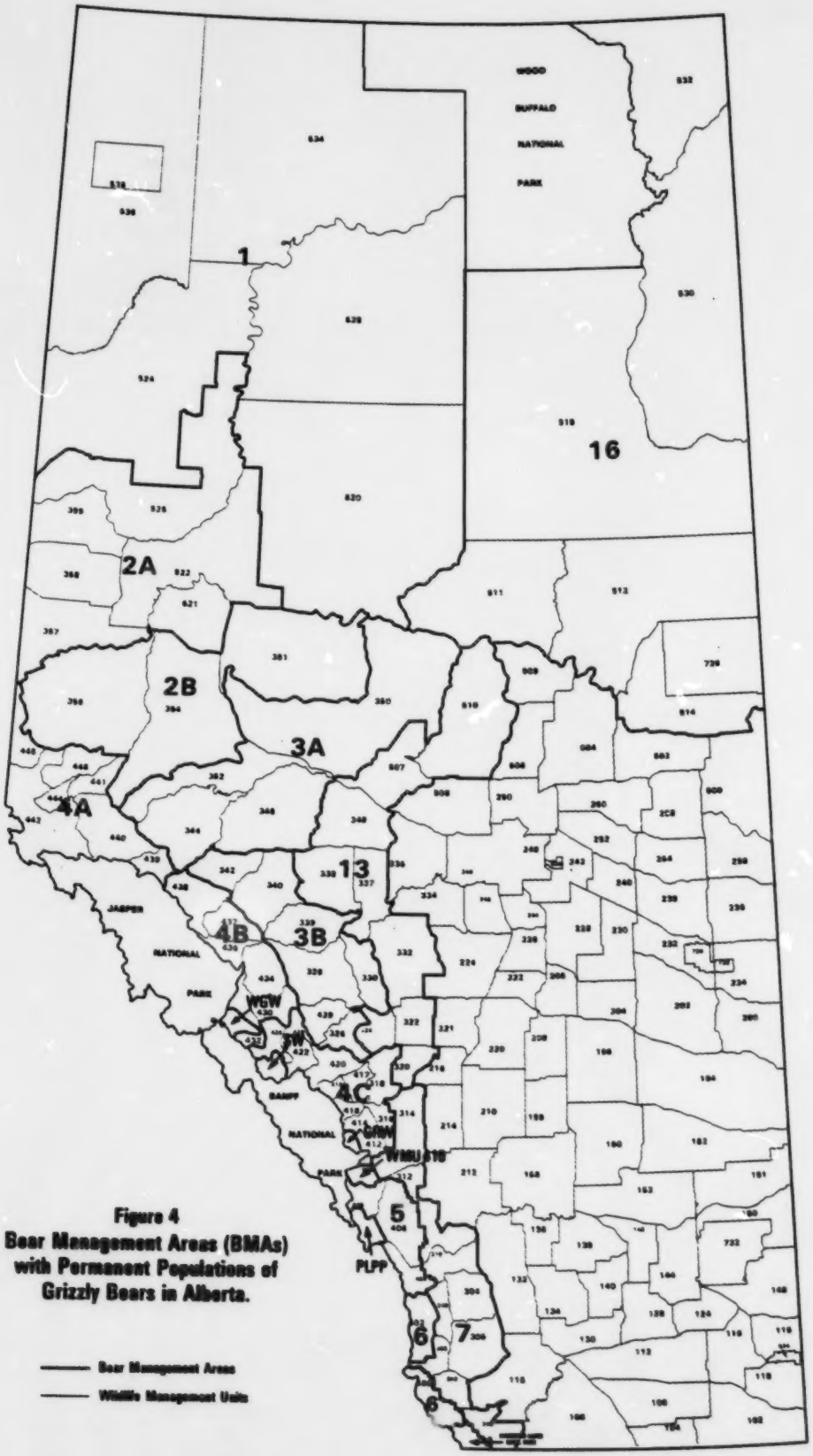

Figure 4
Bear Management Areas (BMAs) with Permanent Populations of Grizzly Bears in Alberta.

——— Bear Management Areas

——— Wildlife Management Units

Table 1. Numbers and types of grizzly bear licences sold and hunter success rates in Alberta.

LICENCE YEAR	TYPE OF LICENCE			ANNUAL HARVEST			ANNUAL % SUCCESS			THREE-YEAR AVERAGE % SUCCESS[b]		
	RES.	NON-RES.[a]	TOTAL	RES.	NON-RES.	TOTAL	RES.	NON-RES.	TOTAL	RES.	NON-RES.	TOTAL
1968-69	349		349									
1969-70	204		204									
1970-71	201	10	211									
1971-72	162	6	168	13	1	14	8	17	8			
1972-73	219	9	228	15	1	16	7	11	7	6	18	6
1973-74	201	7	208	7	2	9	3	29	4	5	10	5
1974-75	263	14	277	11	0	11	4	0	4	5	14	5
1975-76	373	22	395	21	4	25	6	18	6	5	15	5
1976-77	464	17	481	18	4	22	4	24	5	4	16	5
1977-78	560	25	585	17	2	19	3	8	3	3	21	3
1978-79	720	20	740	14	7	21	2	35	3	2	19	3
1979-80	738	33	771	17	6	23	2	18	3	2	19	3
1980-81	996	35	1031	26	4	30	3	11	3	3	16	3
1981-82	894	27	921	24	5	29	3	19	3	3	15	3
1982-83	964	29	993	36	5	41	4	17	4	4	12	4
1983-84	985	57	1042	40	4	44	4	7	4	3	13	4
1984-85	1077	86	1163	28	14	42	3	16	4	3	11	4
1985-86	1192	117	1309	31	10	41	3	9	3	3	9	4
1986-87	967	146	1113	34	9	43	4	6	4			
	AVERAGE						3	12	4			

[a]Nonresident Canadian and nonresident aliens combined.
[b]Values reported for middle year of three-year periods.

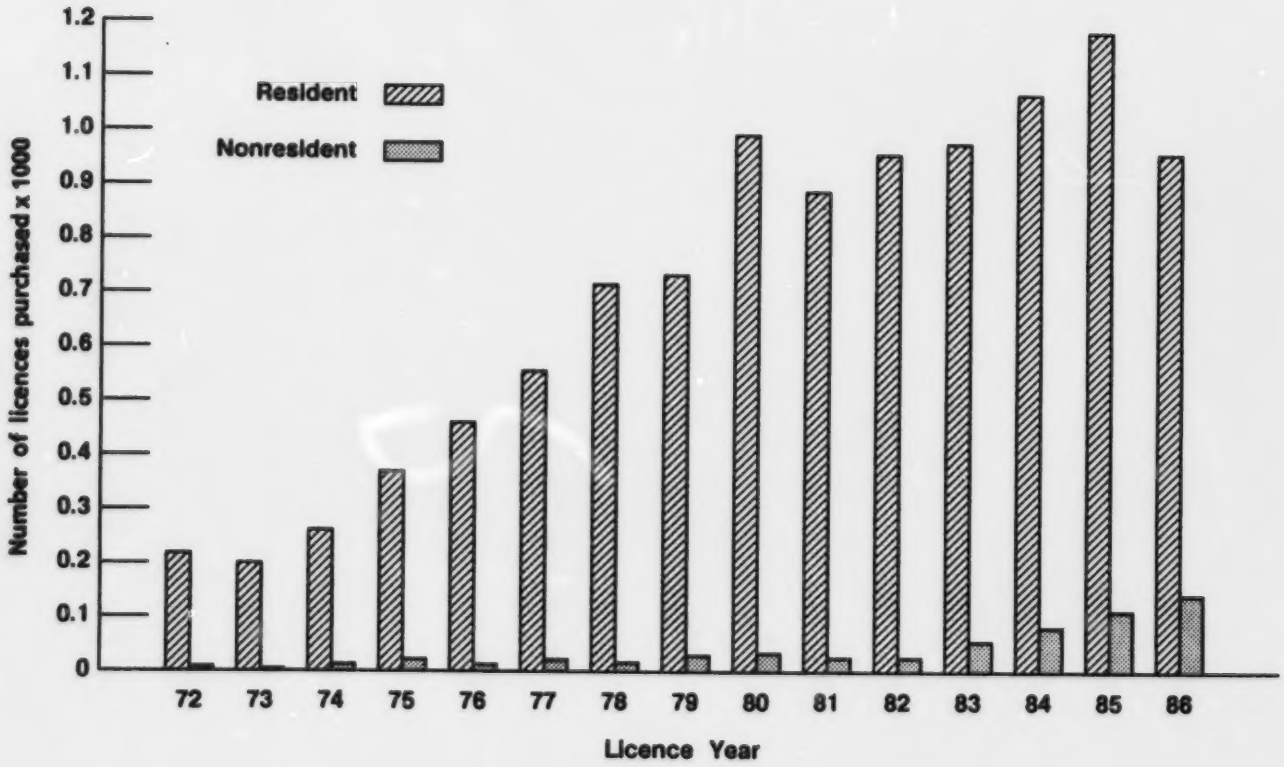

Figure 5. Number of resident and nonresident grizzly bear hunting licences purchased in Alberta, 1972-86.

2.3.2.2.3 Effort and Harvest

Relationships were examined between the annual total legal harvest, including the kill of males and females, and the effort expended in harvesting grizzly bears (Figure 6). Because data on the number of man-days expended in hunting grizzly bears were not available for the entire period, 1972-87 [Adamowicz and Phillips (1981) recorded hunter effort in 1981], the numbers of licences sold annually were used as a crude index of effort (Harris 1984). Trends in the characteristics of the kill, which were associated with increasing effort, were determined using three-year running averages (Figure 6).

The average total annual harvest increased from 12 to 25 bears (100% increase in take) as the average number of licences sold increased from 200 to 850 (350% increase in effort) during the 8 three-year incremental periods 1971-73 to 1978-80 (Figure 6). The increase in harvest of grizzly bears during this period was primarily sustained by an increase in the kill of males from an annual average of 7-10 to 18 males, while the average number of females harvested remained constant at an average of 5-6 bears (range 3-7).

The total harvest increased from an average 27 to 42 bears as licence sales increased from an average of around 850 to 1050 (25% increase in effort) during the next four incremental periods 1979-81 to 1982-84. Although the harvest of males increased during this period from an average of 17 to 25 bears (47% increase), the kill of females increased dramatically from an average of 7 to 17 bears (143% increase). The average total harvest and kill of males and females remained constant in spite of continued increases in number of licences sold during the incremental periods 1983-85 and 1984-86.

2.3.2.3 Estimated Economic Value of the Spring Grizzly Bear Hunt

Adamowicz and Phillips (1981) evaluated the socioeconomic characteristics of the spring 1981 Alberta grizzly and black bear hunting activity. Hunting and related expenditures were broken down by residence of hunter and species hunted to determine the regional economic impact of the spring hunt. Direct benefits were estimated as the "extramarket value"

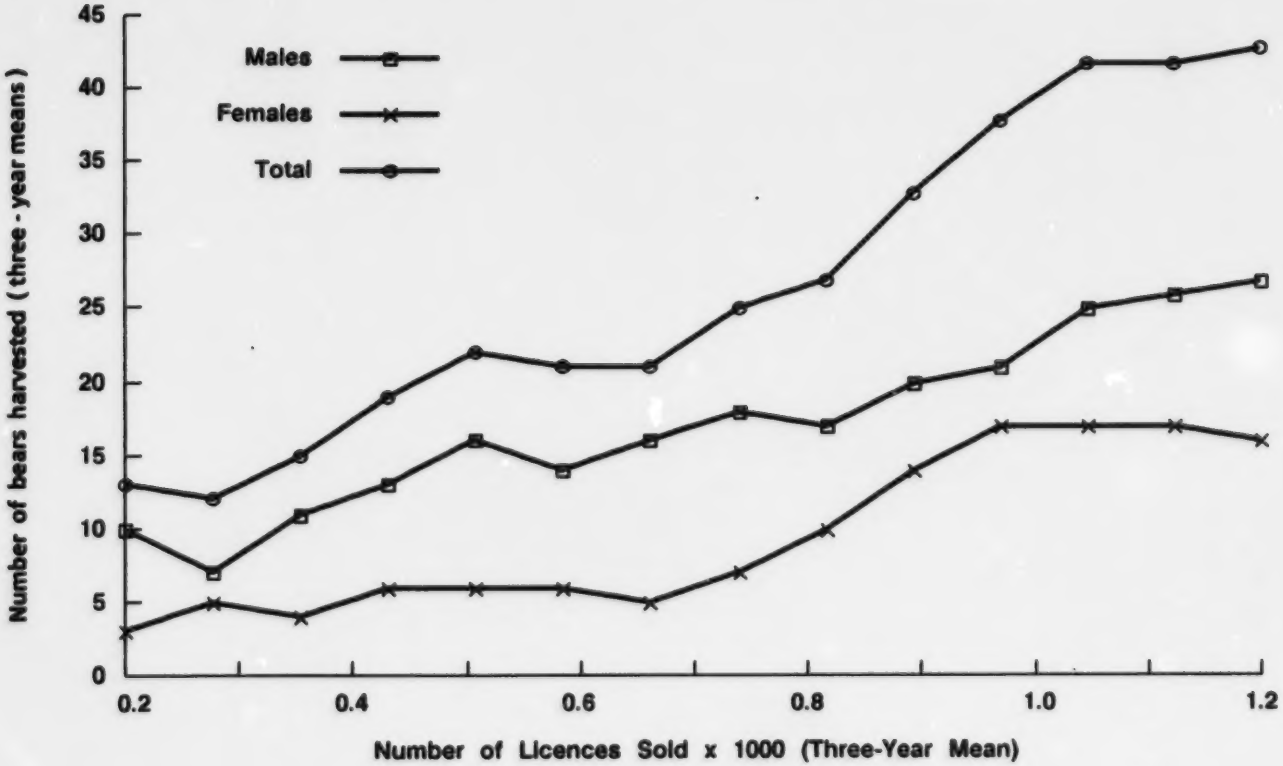

Figure 6. Effect of effort on legal harvest of grizzly bears in Alberta.

(value over and above those revealed in the market such as licence fees). Extramarket benefits were determined using contingent valuation (what hunters are willing to pay to hunt for a day) and compensation methods (what is the minimum amount a hunter would accept in compensation for not hunting).

In spring 1981, grizzly bear hunters spent approximately $411 318 (residents: $391 857; nonresidents: $27 397) and received extramarket benefits of $412 266 (resident: $391 857; nonresident: $20 409). If the value to be compensated to give up hunting is considered, hunters received benefits of $599 204 (resident: $597 014; nonresident: $2 100). If the average expenditures per hunter in 1981 are used to estimate the amount spent during the 1986-87 season, grizzly bear hunters would have spent approximately $487 000 in 1981 dollars (residents: $373 000; nonresidents: $114 000).

Adamowicz and Phillips (1981) expenditure data showed that the flow of funds into Alberta from nonresident hunters had risen since 1975-77, as had the local economic impacts associated with the proximity to the resource. Expenditure information also showed that spring bear hunting (grizzly and black bear) was a significant source of both new (foreign) and redistributed funds. Nonresidents were a good source of potential revenue in the traditional spring "off season" for guides (Adamowicz and Phillips 1981). Extramarket benefit estimates showed that, while not spending as much, resident hunters received greater value from hunting. Although current data are not available, the economic benefits from nonresident expenditures based on estimates for 1986-87 and the extramarket benefits to residents of grizzly bear hunting have undoubtedly risen significantly since 1981.

Estimates of the economic value of grizzly bears to nonconsumptive users in Alberta are not available. Extramarket benefit valuation studies should be considered in the future.

2.3.2.4 Nuisance/Problem Management

2.3.2.4.1 Provincial Summary - Fish and Wildlife offices recorded 638 grizzly bear related personal or property damage complaints during the 17-year period 1970-86, with 501 or 69% of those recorded during the seven-year period 1980-86 (Figures 7 and 8, Appendix I). The average annual

Figure 7
Distribution of Grizzly Bear Complaints in Alberta during 1980-86.

• Complaints
—— Bear Management Areas

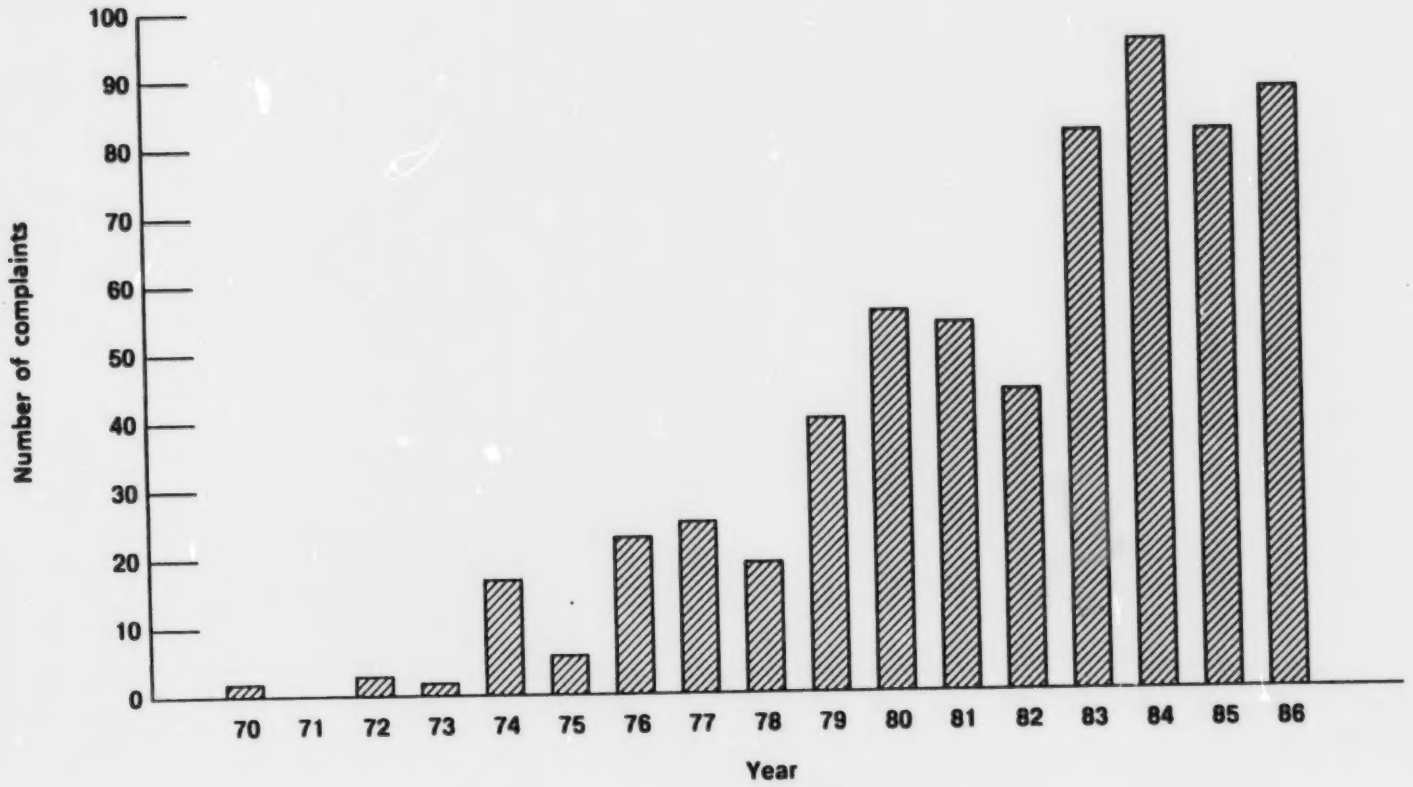

Figure 8. Total numbers of personal/property damage grizzly bear complaints reported during 1970 - 86.

number of complaints recorded increased from 5 to 66 per year during successive five-year periods from 1970-74 to 1980-84 (Table 2). Data for the early 1970s may be incomplete. The 1985-86 annual average stands at 85 complaints/year (Table 2). The continued increase in numbers of complaints during the 1970s and 1980s is probably a result of several factors including the increase in provincial grizzly population (Figure 1), greater use of grizzly habitats by humans, and perhaps, to an increase in reporting rate.

The primary causes of complaints for the 1980-87 period were problematic sightings of grizzly bears in close proximity to areas of human activity (195 or 39% of complaints), harassment of humans (85 or 17% of complaints), and killing of livestock (74 or 15% of complaints) (Table 3). Problematic grizzly bear sightings increased dramatically from an average of five sightings/year during the fiscal years 1980-83 to an average of 45 sightings/year during 1983-87. Similarly, the incidents of reported human harassment increased from an average of five incidents/year during 1980-82 to an average of 15 incidents/year during 1982-86. Incidents involving kills of livestock reached peaks in 1981-82 and 1986-77 of 17 and 16 kills/year, respectively (Table 3).

Grizzly bear damage incidents occurred during the period April-October (494 or 99% of complaints), with peaks occurring during June (87 or 17% of complaints), and September (105 or 21% of complaints) (Appendix I-7, Figure 9). Hunter and Gunson (1980) reported a similar pattern in the timing of the incidents of damage complaints in Alberta for the period 1970-79. Problematic sighting complaints commenced after grizzly bears emerged from winter dens in April-May and peaked in September (Appendix I-6). Incidents of harassment of humans peaked in June, declined in July, and increased to a second peak in September. Kills of livestock occurred in similar proportions during June through September.

The monthly distribution of complaints varied significantly among years (chi-square test of independence, $P<0.05$, Appendix I-7). Three general patterns in the monthly distribution of complaints occurred: (1) during 1980-81 and 1983-84 greater numbers of complaints than expected occurred in July and August, (2) during 1981-82, 1982-83, 1984-85, and 1985-86 greater numbers of complaints than expected were reported during April-May and July or August, and (3) during 1986-87 greater numbers of complaints than expected were reported during April-May, June, and July. The incidents of

Table 2. Numbers of grizzly bear related personal or property damage complaints reported by Fish and Wildlife administrative region, 1970-87.

ADMINISTRATIVE YEAR	FISH AND WILDLIFE ADMINISTRATIVE REGIONS					
	SOUTHERN	CENTRAL	EASTERN SLOPES	PEACE RIVER	NORTH-EAST	TOTAL
1970-71	0	0	2	0	0	2
1971-72	0	0	0	0	0	0
1972-73	0	0	3	0	0	3
1973-74	0	0	0	2	0	2
1974-75	1	1	4	6	5	17
AVERAGE 1970-75	0.2	0.2	1.8	1.6	1.0	4.8
1975-76	1	0	1	3	1	6
1976-77	2	7	0	13	1	23
1977-78	3	4	3	14	1	25
1978-79	3	1	5	10	0	19
1979-80	11	7	8	10	4	40
AVERAGE 1975-80	4.0	3.8	3.4	10.0	1.4	22.6
1980-81	11	5	20	19	1	56
1981-82	13	4	19	14	4	54
1982-83	9	1	16	17	1	44
1983-84	9	6	47	19	1	82
1984-85	20	2	59	11	3	95
AVERAGE 1980-85	12.4	3.6	32.2	16.0	2.0	66.2
1985-86	6	6	60	7	3	82
1986-87	32	3	45	8	0	88
AVERAGE 1985-87	19.0	4.5	52.5	7.5	1.5	85.0
TOTAL	121	47	292	153	25	638

Table 3. Numbers of grizzly bear complaints in Alberta during 1980-87.[a,b]

	CLASSES AND CATEGORIES OF PERSONAL AND PROPERTY DAMAGE														
			KILL	MAULING		HARASSMENT									
YEAR	BEE-YARD	INDUST-RIAL	LIVE-STOCK	LIVE-STOCK	HUMAN	LIVE-STOCK	HUMAN	OTHER	SIGHT-ING	CROP	PROPERTY DAMAGE	PARK/ CAMP	RESID-ENTIAL	OTHER	TOTAL
1980-81	0	13	11	1	0	7	5	0	3	2	1	5	5	3	56
1981-82	0	3	17	0	0	6	4	0	6	0	1	2	4	11	54
1982-83	0	7	9	0	0	0	11	0	7	0	0	2	1	7	44
1983-84	0	1	8	0	0	1	12	0	41	0	2	9	0	8	82
1984-85	1	0	9	3	0	4	18	1	49	0	6	3	0	1	95
1985-86	0	0	4	1	1	6	15	0	48	0	4	2	0	1	82
1986-87	0	0	16	4	0	0	20	0	41	0	0	3	0	4	88
TOTAL	1	24	74	9	1	24	85	1	195	2	14	26	10	35	501

[a]data source: Animal Incident Reporting System (1982-87), District Occurrence Reports (1980-81).
[b]complaints/incidents in national parks are not included.

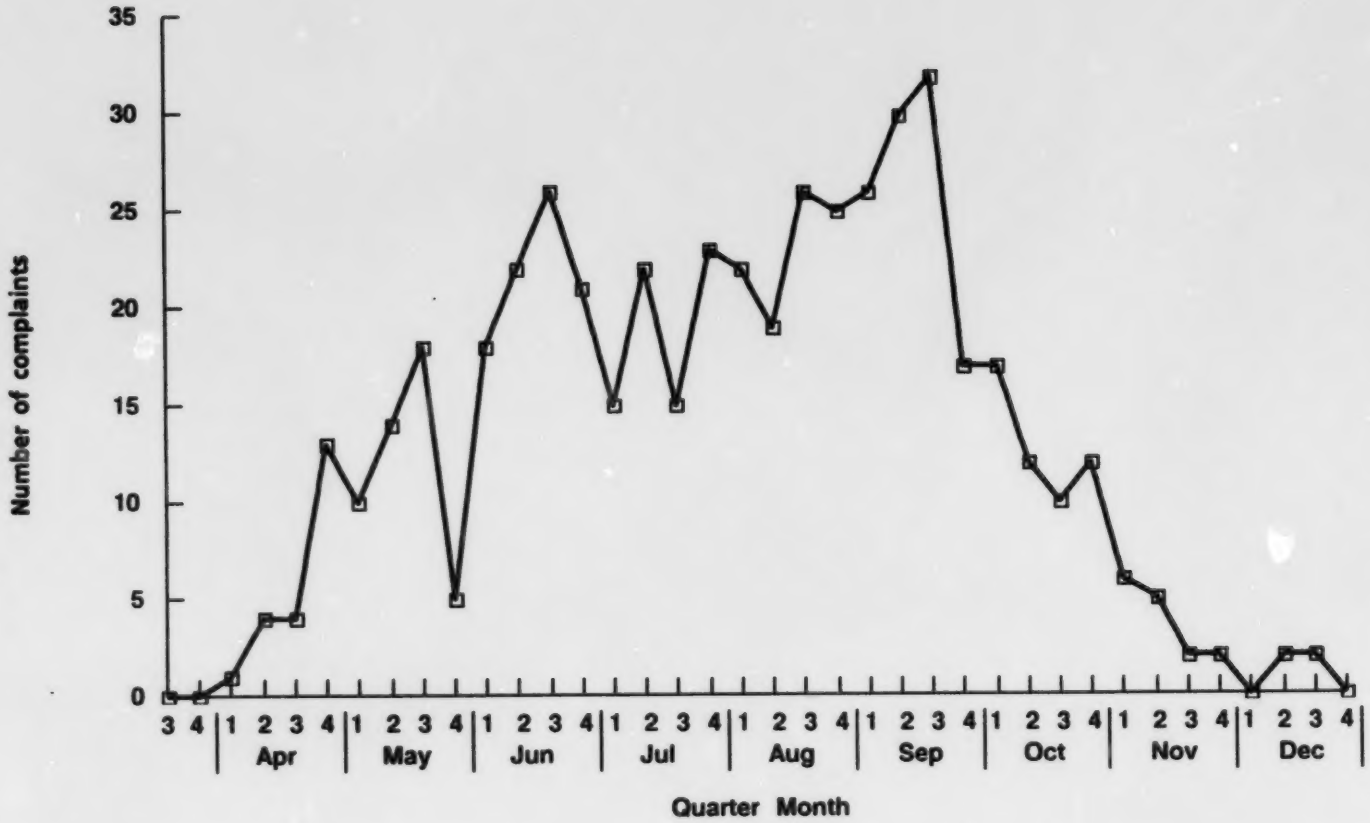

Figure 9. Quarter-monthly distribution of grizzly bear related personal/property damage complaints, 1980 - 86.

complaints during April-May correspond to the post-emergence period when bears are resuming normal activity and breeding. Bears may be more visible because trees and shrubs lack foliage at that time. The variability in occurrence of complaints during July and August may reflect annual variations in the availability of berries and intensity of human activity in areas occupied by bears.

2.3.2.4.2 Complaints by Administrative Regions - A summary of complaints by administrative region is provided in Appendix I. The Eastern Slopes administrative region recorded the greatest number of complaints (292 or 46% of total), followed by Peace River (153 or 24% of total) and Southern regions (121 or 19% of total) (Table 2). The greatest increase in complaints occurred in the Eastern Slopes Region, increasing from an average of two complaints/year during 1970-74 to three complaints/year during 1975-79, to 32 complaints/year during 1980-84, and to 53 complaints/year during 1985-86 (Table 2, Figure 10). Similarly in the Southern Region, the number of complaints received increased from an average of less than one complaint/year during 1970-74 to 19 complaints/year during 1985-86. The annual average in the Peace River Region increased from two complaints/year during 1970-74 to 16 complaints/year during 1980-84. Complaints in that region declined to eight complaints/year during 1985-86. The average annual number of complaints recorded in the Central and Northeast regions remained relatively constant.

The primary cause of complaints in the Southern and Central regions were kills of livestock (39% and 33% of regional complaints, respectively), followed by sightings (25% and 26%, respectively) and harassment of humans and livestock (19% and 30%, respectively) (Table 4). The primary causes of complaints in the Northeast Region were similar (Table 4). In contrast, the primary causes of complaints in the Eastern Slopes and Peace River regions were sightings (48% and 32% of regional complaints, respectively), and harassment of humans (18% and 21% of regional total, respectively).

The greatest proportion of sightings (185 or 66% of total sightings) and human harassment complaints (49 or 58% of total harassment complaints) occurred in the Eastern Slopes Region (Table 4). Kills of livestock occurred primarily in the Southern and Eastern Slopes regions (17 or 23% of total kills).

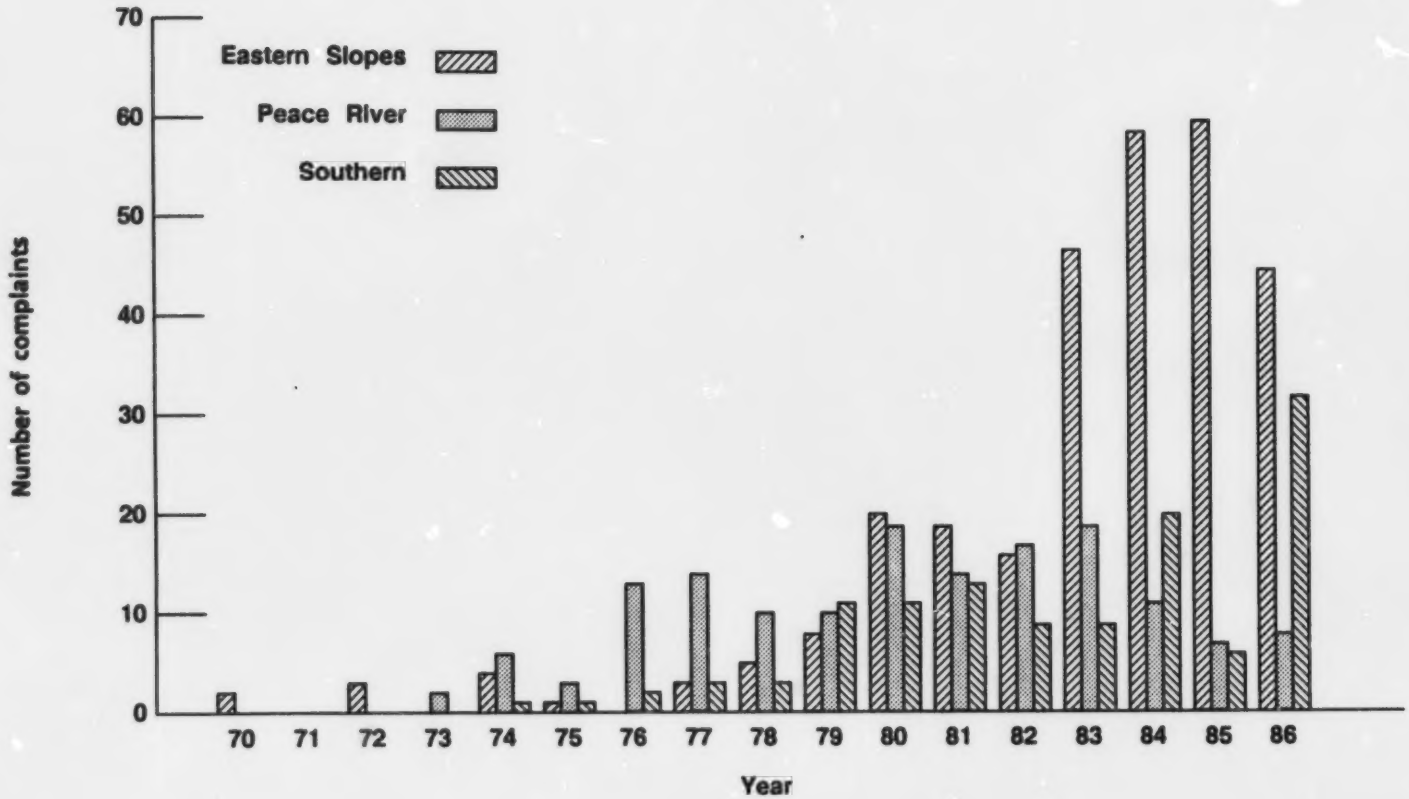

Figure 10. Yearly distribution of grizzly bear complaints for the Eastern Slopes, Peace River, and Southern administrative regions, 1970 - 86.

Table 4. Numbers of personal and property damage grizzly bear complaints by year and region in Alberta, 1980-87.

	CLASSES AND CATEGORIES OF PERSONAL AND PROPERTY DAMAGE														
			KILL	MAULING		HARASSMENT									
ADMINISTRATIVE REGION	BEE-YARD	INDUST-RIAL	LIVE-STOCK	LIVE-STOCK	HUMAN	LIVE-STOCK	HUMAN	OTHER	SIGHT-ING	CROP	PROPERTY DAMAGE	PARK/ CAMP	RESID-ENTIAL	OTHER	TOTAL
SOUTHERN	1	0	39	4	0	8	11	0	25	2	2	3	1	4	100
CENTRAL	0	0	9	0	0	3	5	0	7	0	1	0	1	1	27
EASTERN SLOPES	0	16	17	2	1	4	49	1	129	0	6	20	3	18	266
PEACE RIVER	0	8	7	3	0	6	20	0	30	0	3	3	3	12	95
NORTHEAST	0	0	2	0	0	3	0	0	4	0	2	0	2	0	13
TOTAL	1	24	74	9	1	24	85	1	195	2	14	26	10	35	501

The general pattern of the timing of complaints was most similar in the Southern and Peace River regions (Appendix I-9). Occurrences of complaints commenced in April after bears emerged from winter dens, peaked in June, declined in July, increased to a second peak in August or September, and then declined into October and November. This pattern most likely reflects the seasonal activity patterns of grizzly bears. The peak in complaints in early summer corresponds to the commencement of post-denning activity and the breeding season, while that in late summer corresponds to their hyperphagic period. The magnitude of the second peak may vary from year to year in relation to the availability of natural, late summer foods such as berries.

In comparison, in the Eastern Slopes Region complaints were first recorded in April, increased to a peak in September, and then declined into the fall period. This pattern may reflect the combined effects of the seasonal activity cycles of grizzly bears and that of backcountry recreationists.

<u>2.3.2.4.3 Complaints by WMU and BMA</u> - The regional distribution of complaints was examined by WMU and BMA (Figure 11) for the seven-year period 1980-86 (Appendix I-3). The greatest number of complaints were recorded in Peter Lougheed Provincial Park (36 complaints), WMU 300 (36 complaints), WMU 408 (35 complaints), and WMU 302 (33 complaints) (Appendix I-3, I-10); these averaged to five complaints/year in each area. The leading BMAs in the number of complaints recorded were BMAs 7-9 (87 complaints or 17% of total) and BMA 5 (73 complaints or 15% of total) (Table 5, Figure 11). Additionally, 222 or 44% of complaints occurred in areas south of the Bow River.

Problematic sightings of grizzly bears in close proximity to areas of human activity and harassment of humans were the primary causes of complaints in BMAs 2A, 2B, 3A, 4A, 4B, 5, 6, and 11-16, and in Peter Lougheed Provincial Park (Table 6). Kills of livestock were the primary causes of complaints in BMAs 4C and 7-9 (Table 6). Industry-related and harassment-of-human complaints were the primary causes of incidents in BMA 1.

With the exception of Peter Lougheed Provincial Park, the general timing of complaints were similar in all BMAs (Appendix I-12). The

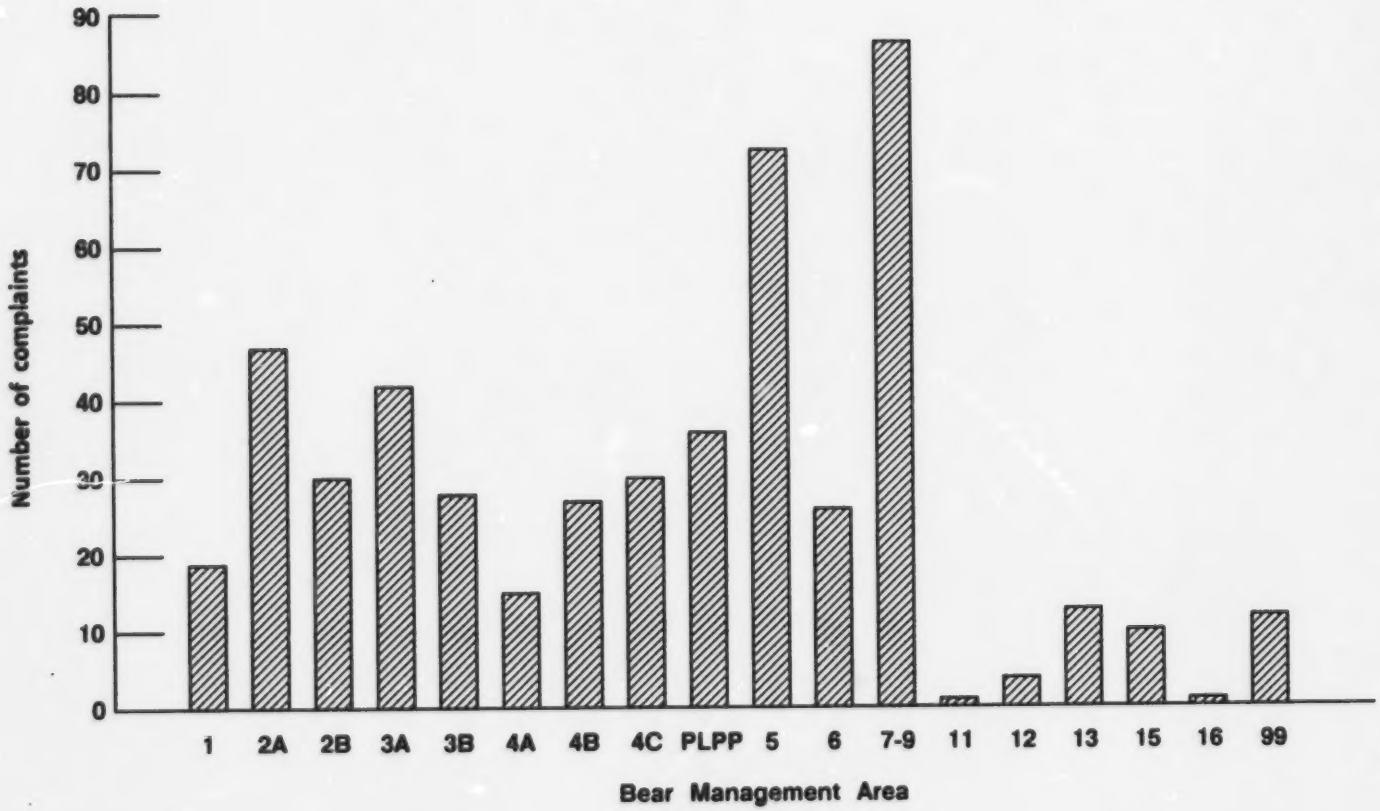

Figure 11. Number of grizzly bear personal/property damage complaints by Bear Management Area, 1980-86.

Table 5. Numbers of grizzly bear related personal or property damage complaints by Bear Management Area (BMA) and year, Alberta, 1980-87.

BMA	YEAR 1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	TOTAL	ZONE TOTAL
1	3	8	7	1	0	0	0	19	19
2A	8	3	3	12	10	5	6	47	
2B	7	2	4	5	1	8	3	30	77
3A	11	5	8	8	5	2	3	42	
3B	2	8	6	1	8	2	1	28	70
4A	0	3	0	2	5	3	2	15	
4B	2	0	1	10	7	3	4	27	
4C	3	5	2	5	4	5	6	30	72
PLPP[a]	0	0	0	2	10	23	1	36	36
5	0	2	1	17	18	13	22	73	73
6	1	2	2	4	4	2	11	26	26
7-9	13	12	7	10	17	8	20	87	87
11	0	0	0	0	1	0	0	1	1
12	0	2	0	0	1	1	0	4	4
13	4	2	2	1	1	2	1	13	13
410	0	0	0	1	1	3	5	10	10
16	0	0	0	0	1	0	0	1	1
99	2	0	1	2	2	2	3	12	12
TOTAL	56	54	44	81	96	82	88	501	501

[a] PLPP - Peter Lougheed Provincial Park

Table 6. Classes[a] and categories[a] of personal and property damage by Bear Management Area (BMA) in Alberta, 1980-87.

	CLASSES AND CATEGORIES OF PERSONAL AND PROPERTY DAMAGE															
BMA	01	05	06		07		08			10	11	12	13	15	99	TOTAL
	99	1-99	1-9	99	1-5	10	1-6	10	99		1-99	1-99				
1	0	6	0	1	0	0	0	5	0	2	0	0	0	1	4	19
2 A	0	0	5	0	3	0	4	6	0	21	0	2	2	1	3	47
2 B	0	4	1	0	0	0	2	4	0	12	1	2	1	1	2	30
3 A	0	5	3	2	1	0	0	7	0	15	0	1	3	3	2	42
3B	0	1	3	0	0	0	3	8	0	6	0	0	0	0	7	28
4 A	0	0	0	0	1	0	0	2	0	6	0	0	0	1	5	15
4 B	0	3	0	0	0	0	0	5	1	10	0	2	5	0	1	27
4 C	0	1	10	0	0	1	0	6	0	3	0	2	4	0	3	30
PLPP[b]	0	0	0	0	0	0	0	4	0	30	0	0	2	0	0	36
5	0	0	0	3	0	0	0	17	0	47	0	1	4	0	1	73
6	0	0	1	0	0	0	0	8	0	15	0	0	0	0	2	26
7-9	1	0	41	0	4	0	12	4	0	13	1	3	3	2	3	87
11-16	0	4	4	0	0	0	3	3	0	12	0	0	0	1	2	29
99	0	0	0	0	0	0	0	6	0	3	0	1	2	0	0	12
TOTAL	1	24	68	6	9	1	24	85	1	195	2	14	26	10	35	501

[a]Classes and categories of personal/property damage:

01(99)	beeyard	08(99)	harassment-other
05(1-99)	industrial group	10	sightings
06(1-9)	kill-livestock	11(1-99)	crop
06(99)	kill-other	12(1-99)	other property damage
07(1-5)	mauling-livestock	13	park/campground
07(10)	mauling-humans	15	residential
08(1-6)	harassment-livestock	99	other
08(10)	harassment-humans		

[b]PLPP - Peter Lougheed Provincial Park

occurrence of complaints commenced in April-May, peaked in May, June or July, declined in July or August, peaked in August or September, and then declined into the fall period. This pattern coincides with the normal seasonal breeding and foraging activities of grizzly bears. In Peter Lougheed Provincial Park, the occurrence of complaints commenced as early as April, increased through the spring and summer months, and peaked in September. This was followed by a dramatic decline in October. This pattern reflects the combined effects of the seasonal activity patterns of grizzly bears and backcountry recreationists.

2.3.2.4.4 Regional Concentrations - Of the incidents leading to complaints, 62% occurred in four primary concentration areas--the Waterton-Crowsnest Pass (20%), Kananaskis-Canmore (24%), headwaters of the Red Deer River (9%), and the Hinton-Cadomin areas (11%) (Table 7).

The primary causes of complaints in the Waterton-Crowsnest Pass areas were kills of livestock (34 complaints or 37%), sightings (27 complaints or 29%), and harassment of humans (11 complaints or 12%) (Table 8). A similar pattern occurred in the headwaters of the Red Deer River, where the primary causes of complaints were livestock kills (11 complaints or 26%), harassment of humans (6 complaints or 14%), and sightings (6 complaints or 14%).

In contrast, in the Kananaskis-Canmore area sightings were the primary complaint (85 complaints or 70%), followed by harassment of humans (25 complaints or 21%). The complaint incidents occurred primarily in Peter Lougheed Provincial Park or along the Canmore corridor. Similarly in the Hinton-Cadomin area, sightings were the primary cause of complaints (16 complaints or 23%), and park/campground (6 complaints or 11%). Complaint incidents occurred primarily around the Hinton town dump or around the town of Cadomin.

In the Waterton-Crowsnest Pass, Red Deer River, and Hinton-Cadomin areas, peaks in the incidents of complaints occurred in May or June, declined in July or August, and peaked again in August or September (Appendix I-15, Figure 12). In the Kananaskis-Canmore area incidents of complaints increased from April through the spring and summer months to peak in September. This was followed by a decline in October.

Table 7. Numbers of grizzly bear related personal or property damage complaints by area of regional concentration and year, Alberta, 1980-87.

REGIONAL CONCENTRATION	YEAR							TOTAL
	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	
WATERTON-CROWSNEST	11	7	9	11	21	6	31	96
KANANASKIS-CANMORE	0	0	1	23	29	39	29	121
RED DEER RIVER	7	5	2	7	5	11	6	43
HINTON-CADOMIN	3	9	4	12	18	3	4	53
TOTAL	21	21	16	53	73	59	70	313

Table 8. Incidence of types of grizzly bear related personal or property damage complaints by area of regional concentration, Alberta, 1980-87.

TYPES OF PERSONAL OR PROPERTY DAMAGE	REGIONAL CONCENTRATION				
	WATERTON-CROWSNEST	KANANASKIS -CANMORE	RED DEER RIVER	HINTON-CADOMIN	TOTAL
BEEYARD	1	0	0	0	1
INDUSTRIAL	0	1	3	2	6
KILL LIVESTOCK	35	0	11	2	48
KILL OTHER	0	3	0	0	3
MAULING LIVESTOCK	4	0	0	0	4
MAULING HUMANS	0	0	1	0	1
HARASS LIVESTOCK	7	0	4	1	12
HARASS HUMANS	11	25	6	12	54
HARASS OTHER	0	0	1	0	1
PROBLEMATIC SIGHTING	27	85	6	16	134
CROP	1	0	0	0	1
OTHER PROPERTY	3	1	3	2	9
PARK/CAMPGROUND	3	5	4	6	18
RESIDENTIAL	0	0	1	1	2
OTHER	4	1	3	11	19
TOTAL	96	121	43	53	313

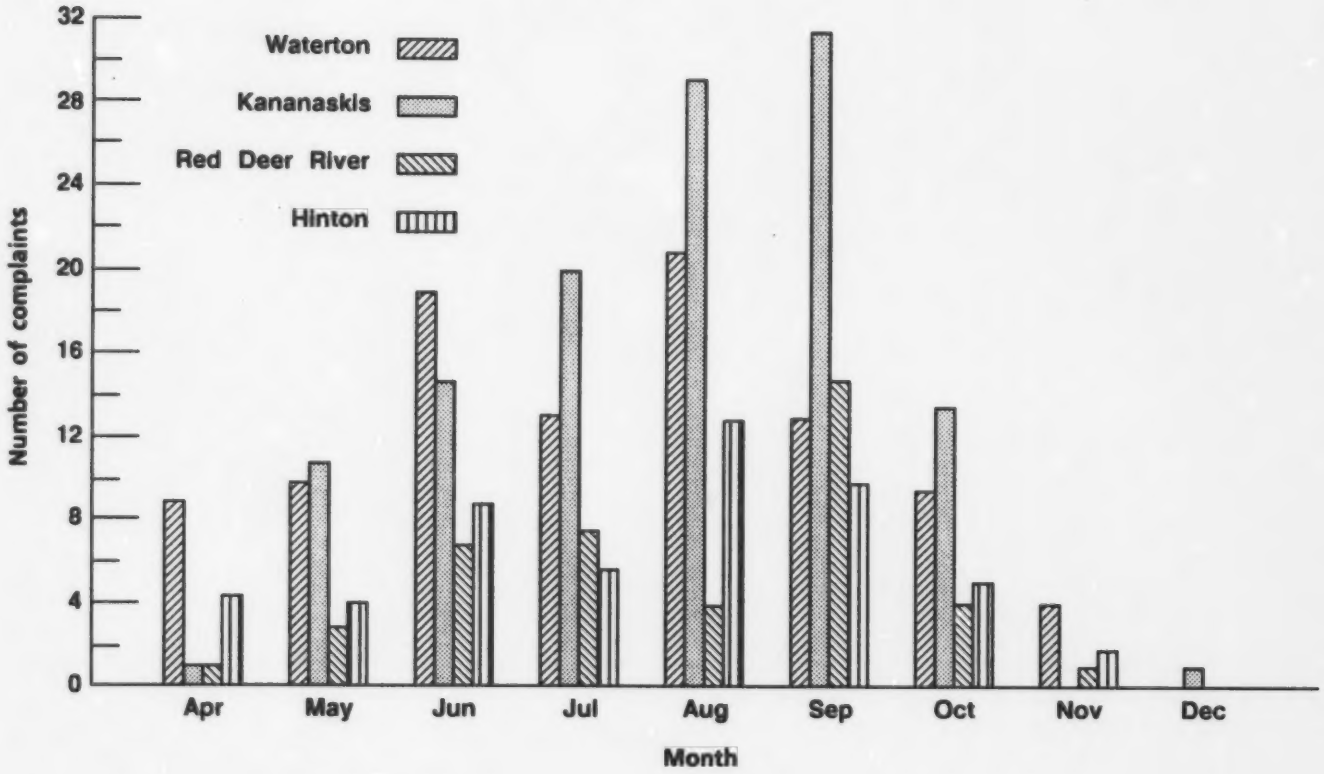

Figure 12. Number of grizzly bear personal / property damage complaints reported by regional concentration area and month, 1980-86.

2.3.2.5 Translocations

Problem wildlife incidents resulted in the translocation of 68 grizzly bears (32 males, 25 females, and 11 of unknown sex) during 1974-87 (Appendix II-1, Table 9). The greatest proportion of bears were removed from WMU 300 (18 bears), WMU 302 (12 bears), WMU 357 (10 bears), and WMU 350 (7 bears) (Table 9). Female grizzly bears constituted 30%-43% of the bears translocated from those WMUs (Table 10). These are areas where conflicts between grizzly bears and agricultural, industrial and recreational activities have occurred. The greatest proportion of bears were translocated to WMU 434 (7 bears), WMU 414 (7 bears), WMU 442 (8 bears), WMU 524 (5 bears), WMU 356 (5 bears), and WMU 328 (5 bears) (Table 9).

The greatest proportion of translocated bears were subadults (<6 years) (51 bears or 74%), with two-, three-, and four-year old bears constituting 60% of the total of 41 bears (Figure 13). Sixty-three percent and 84% of the males and females, respectively, were subadult bears. The greatest proportion of the males were translocated during July and August (17 bears or 53% of total males), while most females were moved during August and September (16 bears or 64% of females) (Figure 14). Bears were translocated distances of 25 km to 170 km during 1974-79, and 150 km to 430 km during 1980-87 (Table 11).

Permanent grizzly bear release areas were identified in 1982 by a Fish and Wildlife Division Bear Management Task Force. Nine release areas were selected to standardize field operations, provide required resources for grizzlies, and ensure public safety.

Area		WMU(s)
i)	Panther	412-418
ii)	Headwaters	422-428
iii)	Bighorn	430-432
iv)	Willmore	440-442
v)	Kakwa	442-445
vi)	Clear Hills	524
vii)	Chinchaga River	536
viii)	Buffalo Head Hills	520-528
ix)	Simonette River	354

These areas were selected for the following reasons:

Table 9. Net translocation of grizzly bears by Wildlife Management Units in Alberta.

WMU[a]	BMA[b]	YEAR 74	75	76	77	78	79	80	81	82	83	84	85	86	87	TOTAL
648	PLPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
738	WGW	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
999	BC	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
524	1	0	1	1	0	0	0	0	3	0	0	0	0	0	0	5
357	2A	0	-5	-2	0	0	0	0	-3	0	0	0	0	0	0	-10
351	2B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
354	2B	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
356	2B	0	4	1	0	0	0	0	0	0	0	0	0	0	0	5
344	3A	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
350	3A	-1	-2	0	-2	0	0	0	0	-2	0	0	0	0	0	-7
328	3B	0	0	0	0	0	0	0	0	0	0	0	0	4	1	5
342	3B	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2
340	3B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	3B	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
440	4A	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
442	4A	0	2	0	2	0	0	0	0	2	0	0	0	0	2	8
430	4B	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
432	4B	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
434	4B	0	0	0	0	0	0	0	1	1	0	1	1	1	2	7
438	4B	0	0	0	0	0	0	0	-1	0	-1	-2	0	0	0	-4
316	4C	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
318	4C	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	-1
320	4C	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	-3
414	4C	0	0	0	0	0	0	3	1	0	0	0	0	2	1	7
417	4C	0	0	0	1	0	0	0	-1	0	0	0	0	0	0	0
418	4C	0	0	1	-1	0	1	0	1	0	0	0	0	0	0	2
426	4C	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	-1
428	4C	0	0	0	0	0	0	0	1	1	1	0	0	0	0	3
408	5	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1
400	6	0	0	0	0	0	-1	0	0	0	0	2	0	2	0	3
402	6	0	0	0	1	1	0	0	0	0	0	1	0	0	0	3
300	7	0	0	0	-1	0	-1	-1	-1	0	0	-2	0	-9	-3	-18
302	7	0	0	0	0	-1	0	-3	-2	-2	-1	-2	-1	0	0	-12
410	15	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	-1

[a]WMU - Wildlife Management Unit
[b]BMA - Bear Management Area

Table 10. Percent females in net translocations of grizzly bears by Wildlife Management Unit in Alberta.

		YEAR														
WMU[a]	BMA[b]	74	75	76	77	78	79	80	81	82	83	84	85	86	87	TOTAL
648	PLPP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
738	WGW	-	-	-	-	-	-	100	-	-	-	-	-	-	-	100
999	BC	-	-	-	-	-	100	-	-	-	-	-	-	-	-	100
524	1	-	0	0	-	-	-	-	67	-	-	-	-	-	-	40
357	2A	-	0	50	-	-	-	-	67	-	-	-	-	-	-	30
351	2B	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0
354	2B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
356	2B	-	0	100	-	-	-	-	-	-	-	-	-	-	-	20
344	3A	-	-	-	-	-	-	-	-	-	-	0	-	-	-	0
350	3A	0	100	-	0	-	-	-	-	50	-	-	-	-	-	43
328	3B	-	-	-	-	-	-	-	-	-	-	-	-	50	-	50
340	3B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
342	3B	-	-	-	-	-	-	-	-	-	-	-	-	-	50	50
429	3B	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0
440	4A	-	-	-	-	-	-	-	-	-	0	-	-	-	-	0
442	4A	-	100	-	0	-	-	-	-	50	-	-	-	-	50	50
430	4B	-	-	-	-	-	-	-	100	-	-	-	-	-	-	100
432	4B	-	-	-	-	-	-	-	-	-	-	-	-	-	100	100
434	4B	-	-	-	-	-	-	-	0	0	-	0	100	0	0	17
438	4B	-	-	-	-	-	-	-	0	-	0	0	-	-	-	0
316	4C	-	-	-	-	-	100	-	-	-	-	-	-	-	-	100
318	4C	-	-	-	-	-	-	-	100	-	-	-	-	-	-	100
320	4C	-	-	-	-	-	-	-	-	-	-	-	-	-	100	100
414	4C	-	-	-	-	-	-	67	100	-	-	-	-	50	0	57
417	4C	-	-	-	-	-	-	-	100	-	-	-	-	-	-	100
418	4C	-	-	-	-	-	100	-	0	-	-	-	-	-	-	50
426	4C	-	-	-	-	-	-	100	-	-	-	-	-	-	-	100
428	4C	-	-	-	-	-	-	-	100	0	100	-	-	-	-	67
408	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	6	-	-	-	-	-	100	-	-	-	-	0	-	50	-	0
402	6	-	-	-	0	0	-	-	-	-	-	0	-	-	-	0
300	7	-	-	-	0	-	100	100	100	-	-	0	-	44	0	41
302	7	-	-	-	-	0	-	67	0	0	100	0	100	-	-	36
410	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[a]WMU - Wildlife Management Unit
[b]BMA - Bear Management Unit

Figure 13. Estimated ages of translocated grizzly bears in Alberta (all bears six years and older, and bears estimated to be adults were pooled in the >five year age class).

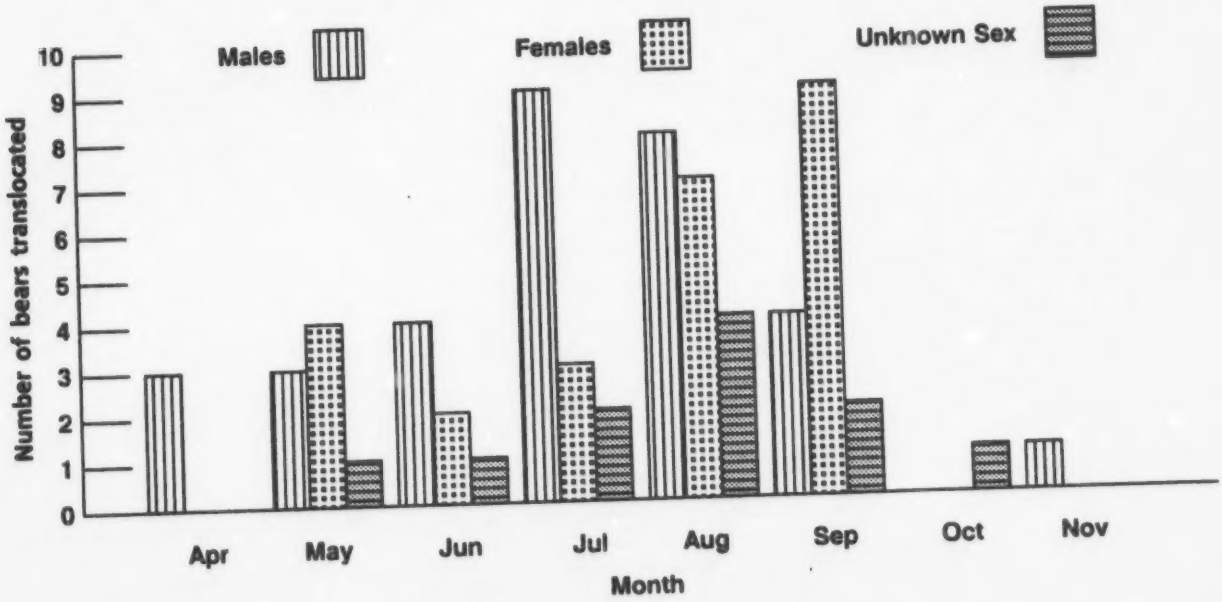

Figure 14. Seasonal distribution of times when males, females, and unknown sex grizzly bears were translocated in Alberta for years 1974-87.

Table 11. Average distance (km) that grizzly bears were translocated in Alberta.

YEAR	N	AVERAGE DISTANCE MOVED (KM)	RANGE
1974	1	25	-
1975	9	164	100-240
1976	4	120	30-240
1977	6	130	20-300
1978	1	90	-
1979	2	170	40-300
1980	5	222	40-270
1981	9	217	35-370
1982	4	338	300-395
1983	2	200	45-355
1984	6	126	10-425
1985	1	420	-
1986	9	277	30-430
1987	9	239	150-430

1) the areas support good quality bear habitats, which are currently or were recently occupied by grizzly bears;

2) although the areas are remote and relatively difficult to access by land, access could be gained on "fair weather" roads if helicopter support was not available or inoperable;

3) backcountry recreational use (hunting and fishing), trapping, and industrial activities occur on a limited scale; and

4) problem bears could be potentially harvested during the spring grizzly bear hunting season.

2.3.3 Total Known Man-Caused Mortality

2.3.3.1 Total Kill and Sex Ratio

A total of 636 known man-caused grizzly bear mortalities (374 males, 209 females, and 53 of unknown sex) was recorded in Alberta during the period 1972-87 (Appendix III, Tables 12 and 13, Figures 15 and 16, Gunson and Treichel 1987). The number of mortalities increased from 18 bears in 1972 to 67 in 1987 (Table 12 and Figure 15). Overall, the sex ratio of the total kill was 64% males to 36% females, but varied with year (Table 13). The proportion of females in the annual total kill ranged from 25%-35% during 1976-81 and increased to a range of 39%-47% during much of the period 1982-87.

2.3.3.2 Causes of Mortality

The primary cause of known man-caused mortality during 1972-87 was legal harvest (68%); however, the proportion of bears killed through legal harvest varied from 35%-94% of the total annual kill (Table 12). On average, 32% (range 6%-65%) of the bears killed annually were removed through causes other than legal harvest including illegal (13%), problem wildlife (8%), self-defense (6%), Treaty Indian (2%), research (1%), and accidental kills (2%) (Table 12, Figure 15).

Table 12. Numbers of grizzly bear mortalities by year and type in Alberta, 1972-87.

CALENDAR YEAR	TYPE OF KILL[a]							TOTAL
	LH	IL	PW	SD	TI	RE	AC	
1972	14	2	0	1	0	0	1	18
1973	16	1	0	0	0	0	0	17
1974	9	4	5	3	5	0	0	26
1975	11	4	2	4	0	0	0	21
1976	25	7	3	0	0	0	3	38
1977	22	4	2	3	1	0	0	32
1978	19	2	5	1	0	0	0	27
1979	21	9	3	0	0	0	0	33
1980	23	6	6	2	0	1	0	38
1981	30	6	4	2	0	3	1	46
1982	29	9	2	5	0	2	1	48
1983	42	7	2	5	3	1	0	60
1984	44	4	3	5	2	0	1	59
1985	42	2	3	4	1	0	3	55
1986	43	4	1	0	1	0	2	51
1987	43	9	8	6	1	0	0	67
TOTAL	433	80	49	41	14	7	12	636

[a]Type of Kill:

LH Legal Harvest
IL Illegal Kill
PW Problem Wildlife
SD Self-defense
TI Treaty Indian
RE Research
AC Accidental

Table 13. Sex ratio of grizzly bears in total kills, legal harvest, and other kills in Alberta during calendar years 1972-1987.

YEAR	TOTAL KILL				LEGAL HARVEST				OTHER KILLS			
	M	F	U	TOTAL	M	F	U	TOTAL	M	F	U	TOTAL
1972	18	0	0	18	14	0	0	14	4	0	0	4
1973	8	8	1	17	8	8	0	16	0	0	1	1
1974	13	7	6	26	8	1	0	9	5	6	6	17
1975	7	10	4	21	5	6	0	11	2	4	4	10
1976	20	9	9	38	15	4	6	25	5	5	3	13
1977	22	8	2	32	14	6	2	22	8	2	0	10
1978	15	8	4	27	11	7	1	19	4	1	3	8
1979	20	6	7	33	14	4	3	21	6	2	4	12
1980	24	8	6	38	17	4	2	23	7	4	4	15
1981	27	15	4	46	16	10	4	30	11	5	0	16
1982	25	21	2	48	15	14	0	29	10	7	2	19
1983	34	22	4	60	26	16	0	42	8	6	4	18
1984	35	23	1	59	23	20	1	44	12	3	0	15
1985	33	22	0	55	25	17	0	42	8	5	0	13
1986	35	15	1	51	30	13	0	43	5	2	1	8
1987	38	27	2	67	26	17	0	43	12	10	2	24
TOTAL	374	209	53	636	267	147	19	433	107	62	34	203

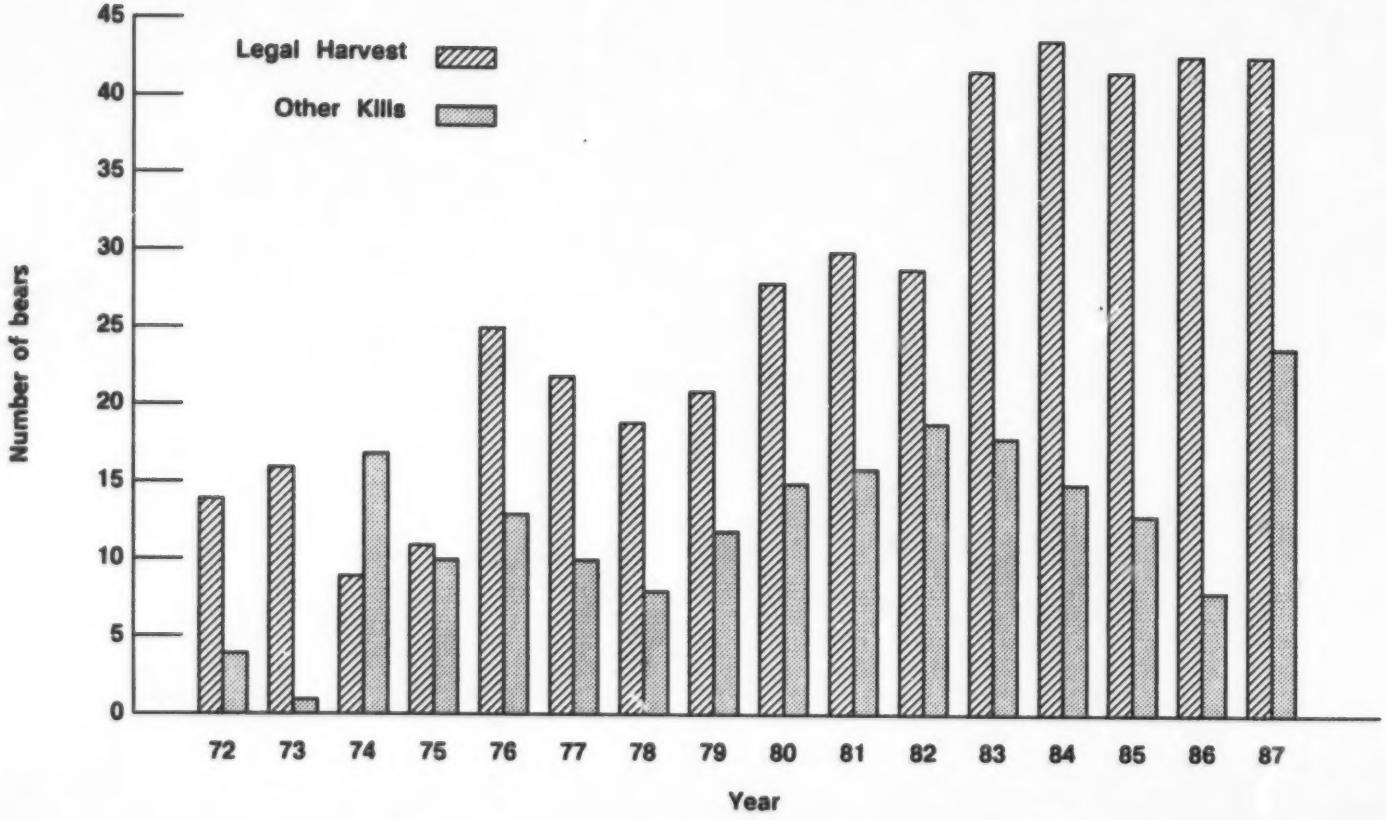

Figure 15. Number of grizzly bear mortalities by year and type in Alberta, 1972 - 87.

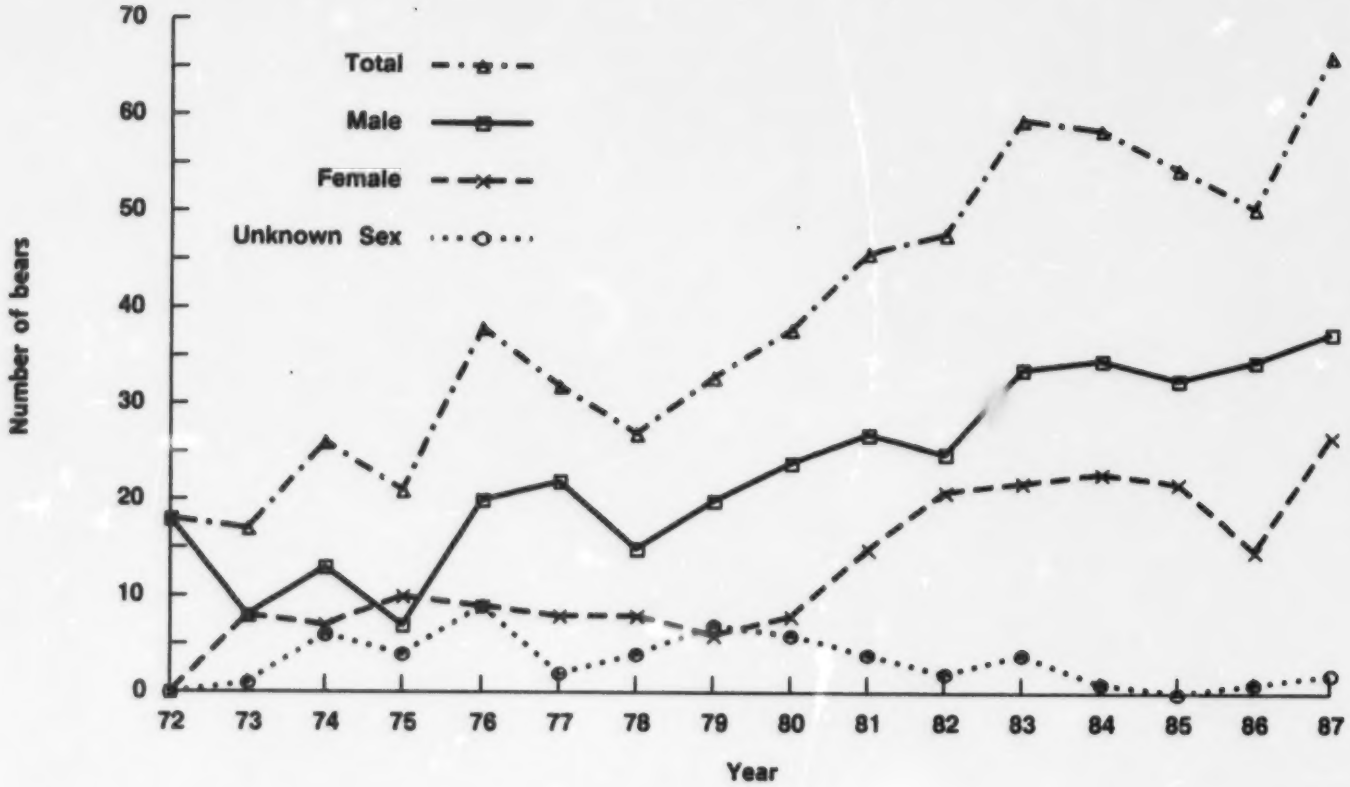

Figure 16. Summary of total kill of grizzly bears in Alberta.

2.3.3.3 Seasonal Timing of Total Kill

The greatest proportion of legal kills (98%) occurred during the spring grizzly bear hunting season from 1 April to 15 June, with a peak in the number of kills occurring during 16-31 May (Figure 17). In contrast, the greatest proportion of illegal (60%) and self-defense kills (75%) occurred during the period 1 September to 15 November (Figure 18 and 19). This latter period is coincident with the fall big game hunting season. Problem wildlife kills occurred with similar frequency during April through October (Figure 20). Figure 21 provides the seasonal distribution of legal and other kills.

2.3.3.4 Distribution of Kills

The locations of kills were plotted for five-year periods, 1977-81 and 1982-86 to identify changes in the spatial distribution of mortality sites and possible areas of overharvest (Figures 22 and 23). Resident bears may be depleted in areas where kill sites are strongly clumped (F. Harper pers. comm.). During 1977-81, kills were distributed primarily in BMAs 2B, 3A, 4A and 4 (Figure 23). Clumping of kill sites occurred in BMAs 4A and 4C where kills were predominantly males.

Similarly during 1982-86, kills were distributed primarily in BMAs 2B, 3A, 4A and 4C (Figure 23). However, an increase in the kills of grizzly bears in the southwestern portion of the province occurred, particularly in BMAs 6 and 7. Clumping of kill sites occurred in BMAs 2B, 4A, 4C and the southern portion of BMA 6. With the exception of BMA 4C, the greatest proportion of bears killed, in areas where strong clumping of kill sites occurred, were females. This suggests that resident female grizzly bears may have been reduced in BMAs 2B, 4A and the southern portion of BMA 6.

2.3.3.5 Age Strucure of Kills

2.3.3.5.1 Comparison of Estimated And Dental Ages - During the period 1972-87, the ages of 199 bears were estimated by personnel of Fish and Wildlife districts, and then, at a later date, determined through readings of cementum annulations. The relationship between estimated and dental ages

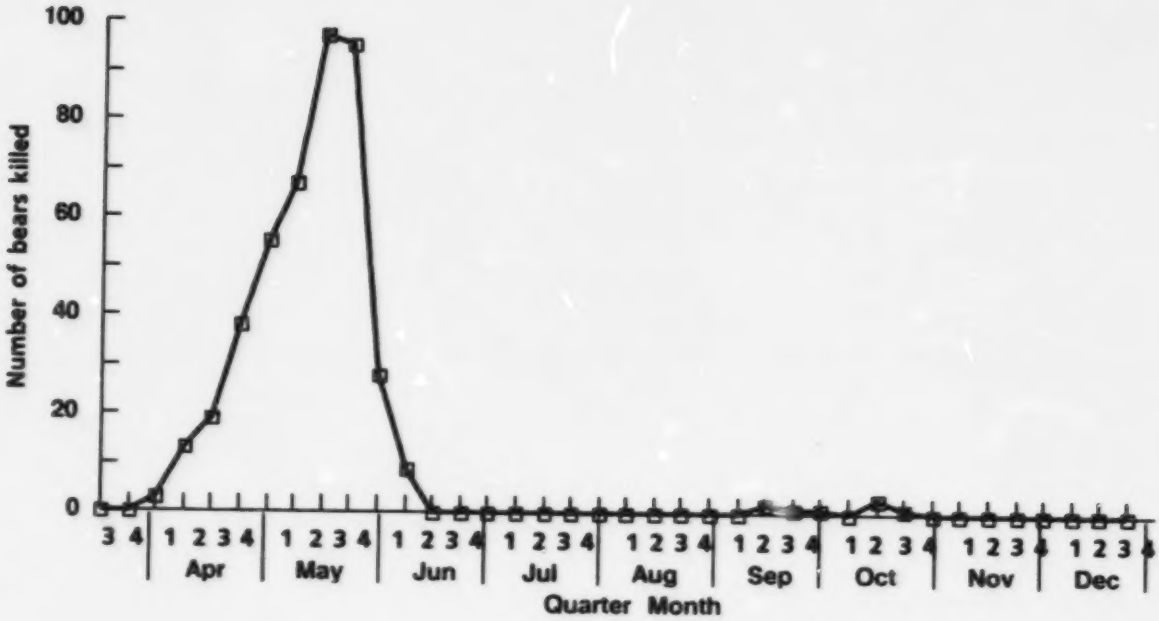

Figure 17. Quarter-monthly distribution of legal kills of grizzly bears in Alberta, 1972-87 (N = 431).

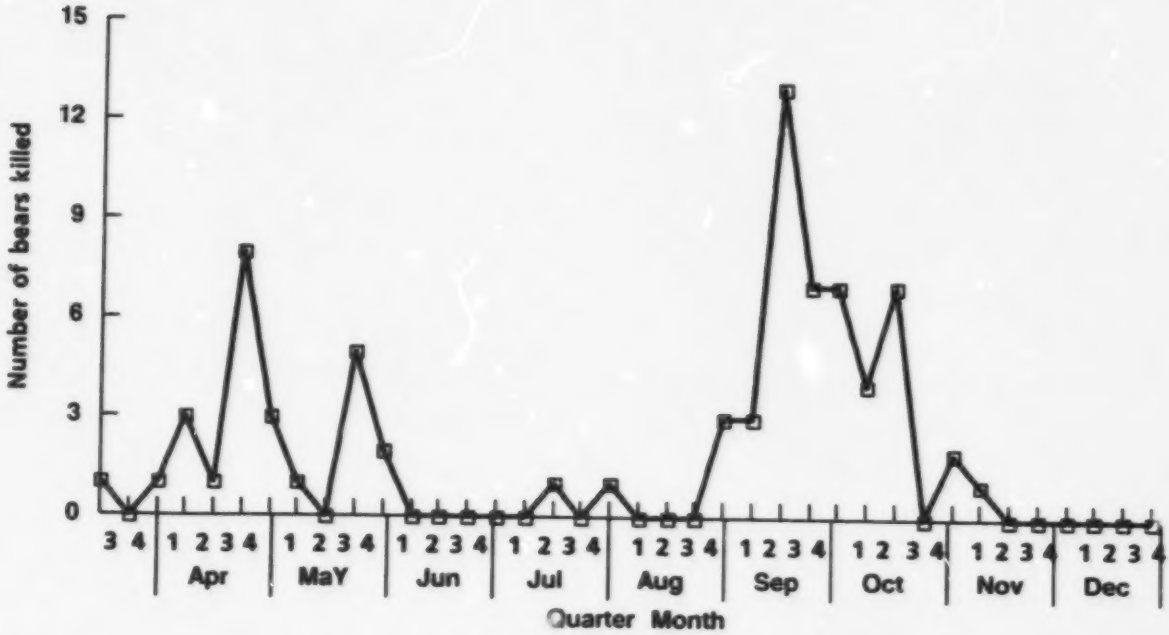

Figure 18. Quarter-monthly distribution of illegal kills of grizzly bears in Alberta, 1972-87 (N = 80).

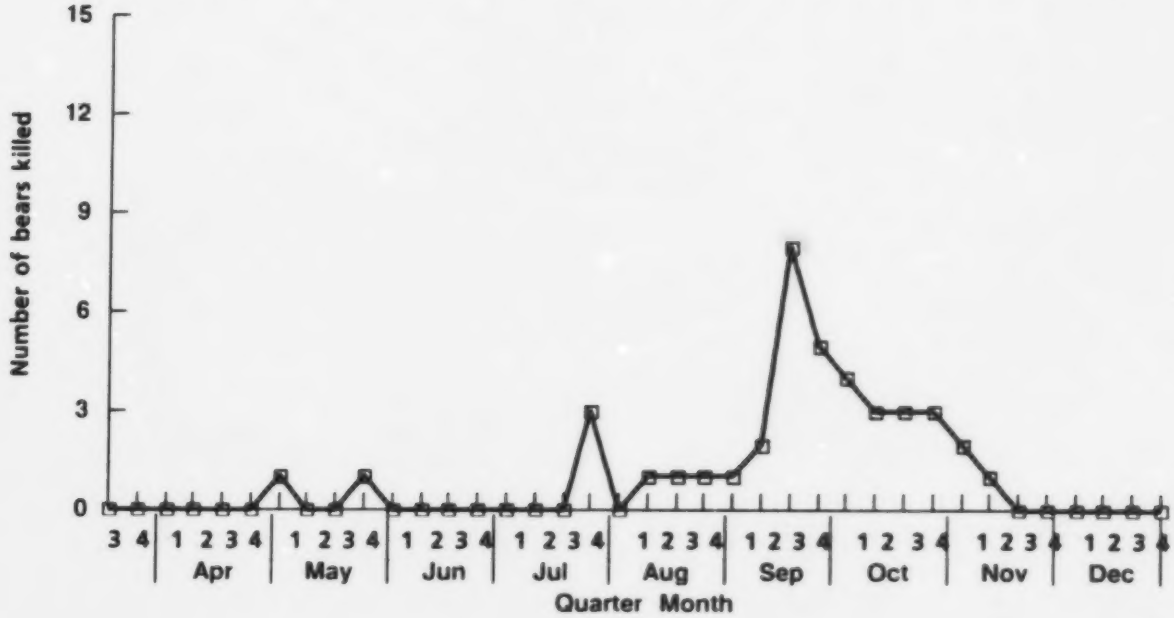

Figure 19. Quarter-monthly distribution of self-defense kills of grizzly bears in Alberta, 1972 - 87 (N = 41).

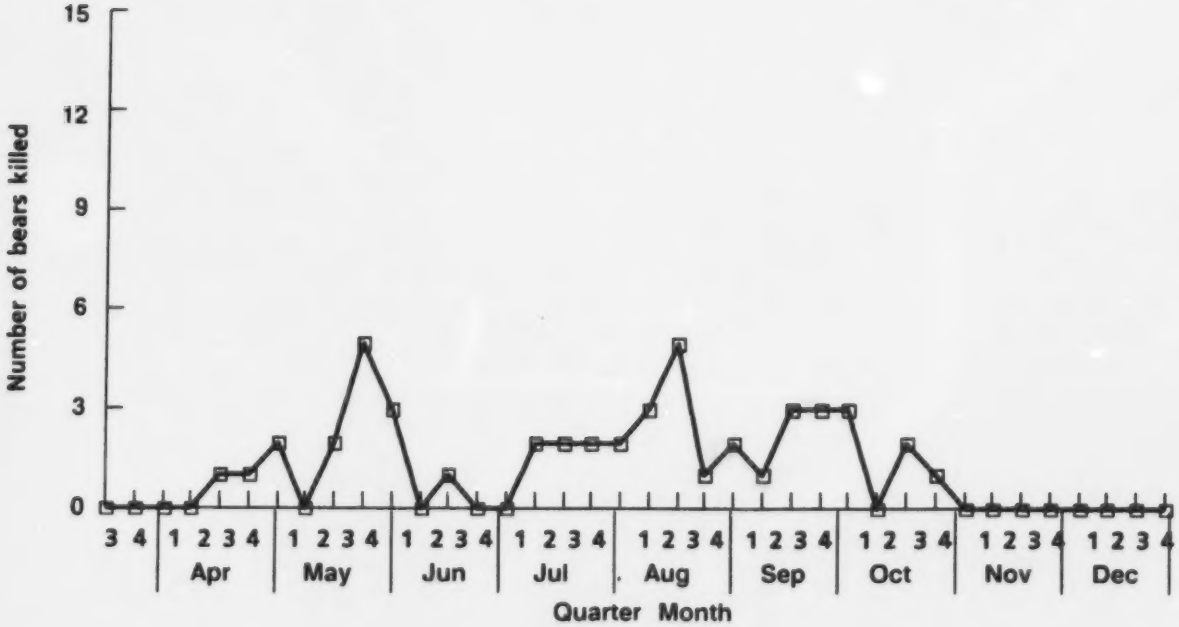

Figure 20. Quarter-monthly distribution of problem wildlife kills of grizzly bears in Alberta, 1972-87 (N = 49).

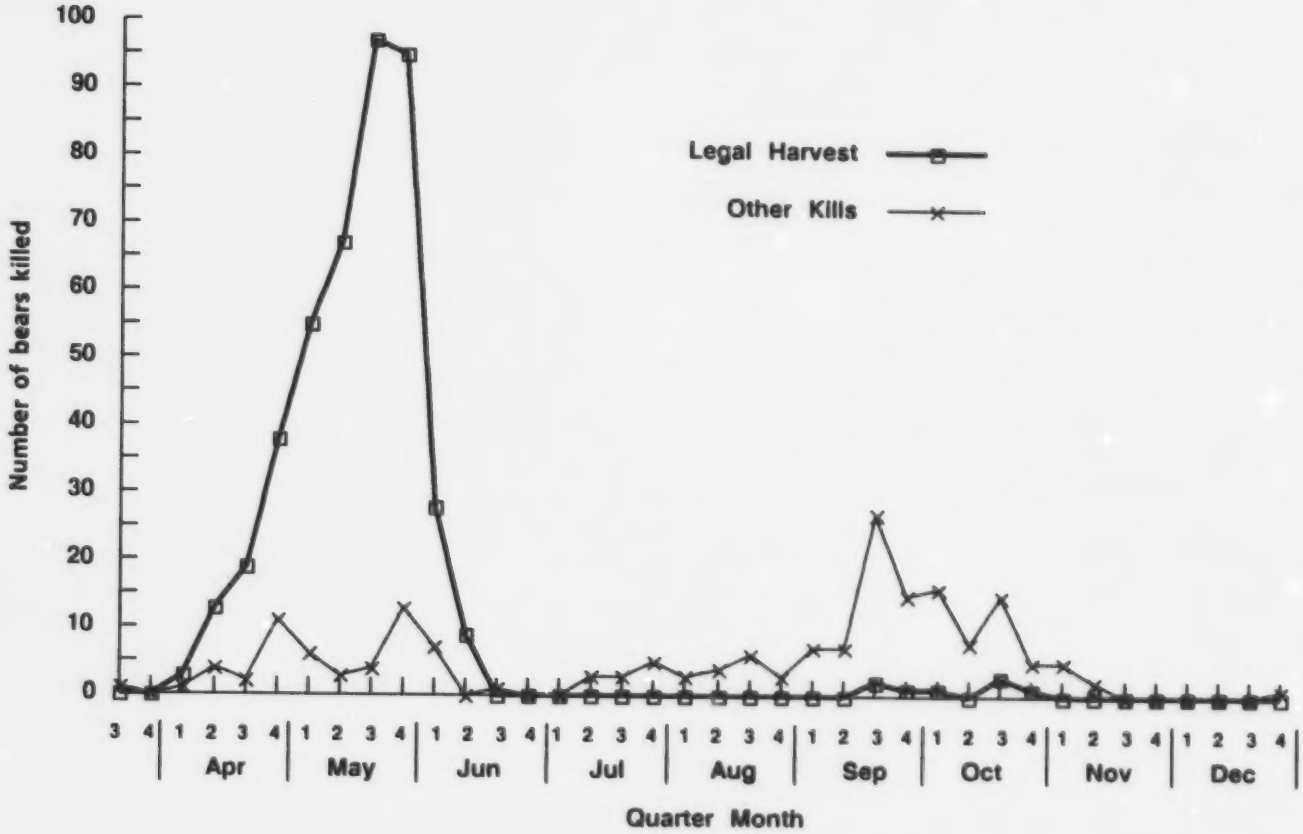

Figure 21. Quarter-monthly distribution of legal and other kills of grizzly bears in Alberta, 1972 - 87.

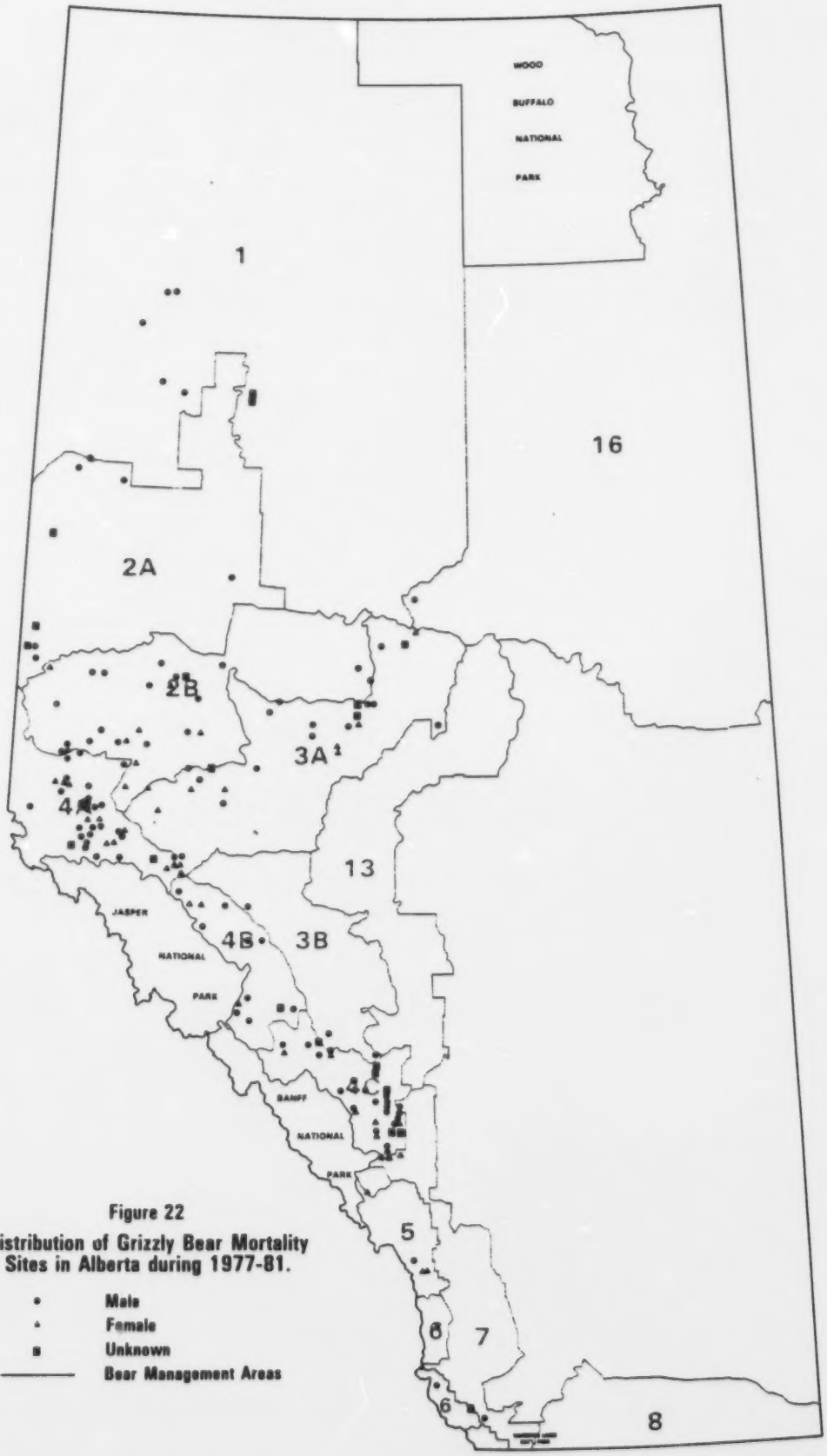

Figure 22
Distribution of Grizzly Bear Mortality Sites in Alberta during 1977-81.

- • Male
- ▲ Female
- ■ Unknown
- ——— Bear Management Areas

Figure 23
Distribution of Grizzly Bear Mortality Sites in Alberta during 1982-86.

- Male
- Female
- Unknown
- Bear Management Areas

was examined using a simple regression of the form $Y = a + bX$, where Y = predicted dental age and X = estimated age. This produced an R-squared value of 43.09% which suggests that a poor correlation existed between the estimated age and the actual age. Bears were then separately classified as subadults ($\leq$5 yr) and adults ($\geq$6 yr) using first the estimated and then the dental ages. Using only those two categories, 83% (166 bears) would have been correctly classified as subadults or adults, 6% (11 bears) would have been estimated to be adults rather than subadults, and 11% (22 bears) would have been estimated to be subadults rather than adults. The analyses suggest that the actual ages of bears were not accurately determined through estimation; however, bears were more reliably classified into age categories (cubs, subadults, adults). In addition to estimating age categories of bears in the field, emphasis must be placed on extracting premolar teeth from dead or translocated bears to obtain accurate ages.

<u>2.3.3.5.2 Trends in Age Structure</u> - Scatter diagrams are provided in Figure 24 which plot dental ages and the annual median age for male and female grizzlies in the total kill during 1975-88 [virtually all dental-aged grizzlies are $\geq$2 yr because teeth from most COYs (0 yr) and yearlings (1 yr) are not collected]. Nonparametric Kruskal-Wallis tests (Gibbons 1985) were used to compare median ages of male and female grizzlies by year. No significant differences were found between years in the age distribution of either males or females in the total kill; independent tests were run for periods 1975-88 and 1981-88.

The observed trend in females during 1982-87 is suggestive of increasing age, although this could be indicative of a shift in selection to adult females in most recent years. Interpretation of trends in age structure can be ambiguous as reported by Caughley (1974),

> "Not only can a massive increase or decrease go completely unmarked by the age-ratios, but the same change in rate of increase can produce quite different age-ratio trends according to how the increase was brought about. Even more bothersome is the coincidence between two populations, one of which may be increasing and the other decreasing."

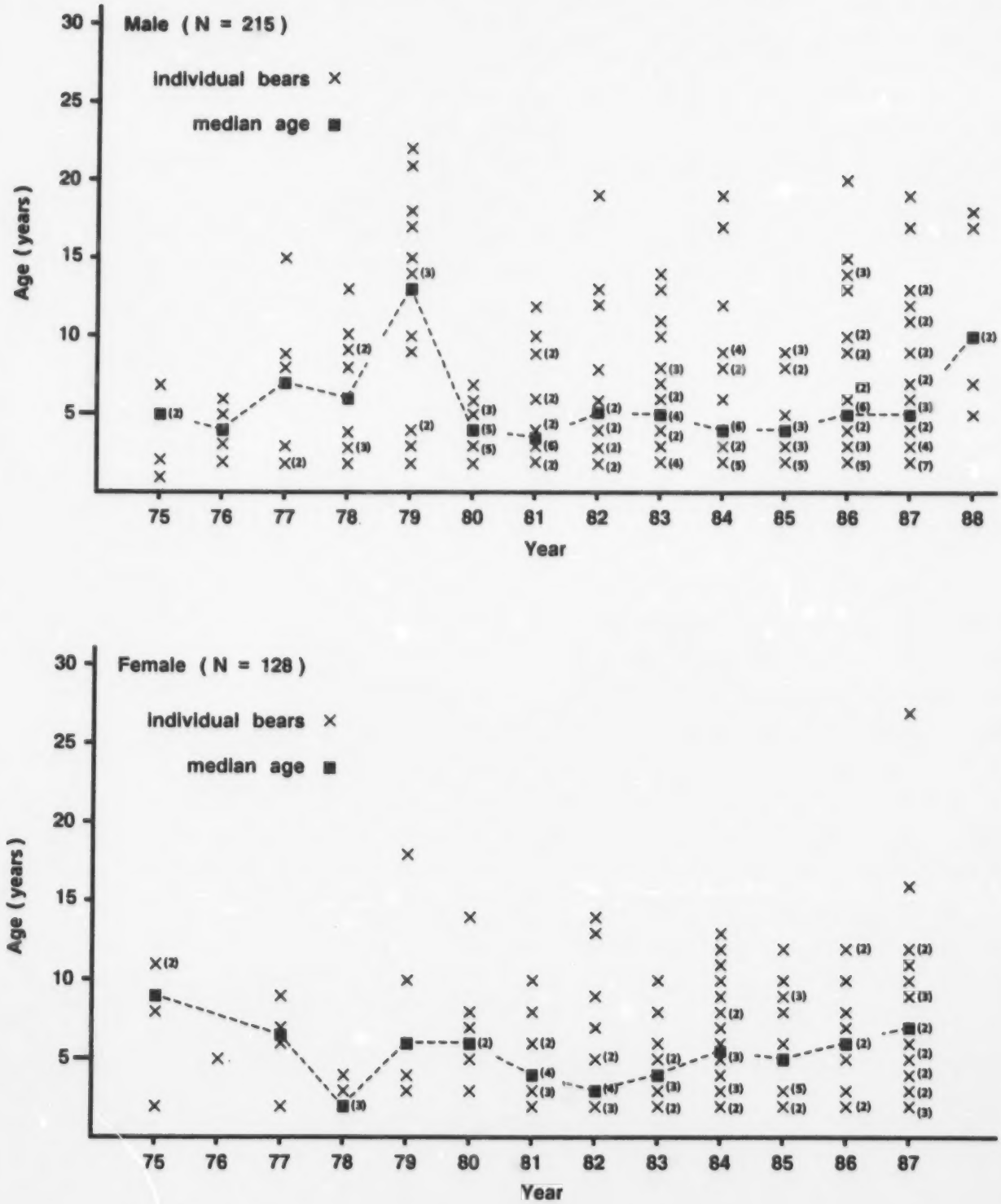

Figure 24. Trends in dental ages of grizzly bears from mortalities in Alberta (number of bears of a particular age in parenthesis).

2.3.4 Legal Harvest

2.3.4.1 Total Legal Harvest and Sex Ratios

A total of 433 grizzly bears (267 males, 147 females, and 19 of unknown sex) were legally harvested in Alberta during 1972-87 (Tables 12 and 13, Figure 25). The number of legal kills increased from 9-16 bears during 1972-75, 19-25 bears during 1976-80, 29-30 bears during 1981-82, and has stabilized at 41-44 bears during 1983-87 (Table 12). The sex ratio of the total legal harvest was 64% males to 36% females, but varied with year (Table 13). The proportion of females in the annual legal harvest ranged from 19%-39% during 1976-81, and increased to 38%-48% during 1982-85 (Table 13).

2.3.4.2 Timing of Legal Harvest

The greatest proportion of males (60%) and females (64%) harvested during the spring legal hunting season were taken during 8-31 May (Figure 26). Spring harvest dates were pooled by sex for the period 1972-87 and their quarter-monthly distribution compared using a chi-square test of independence (Gibbons 1985). The quarter-monthly distribution of kills of males and females were not significantly different ($P>.05$, Figure 26). The cumulative frequency distribution of the legal kills showed that 19% of male and 13% female grizzly bears had been harvested by the end of April, with that proportion increasing to around 90% by the end of May (Figure 27). The greatest kill of females (28%) occurred during 16-23 May.

2.3.5 Regional Analyses of Known Mortality

2.3.5.1 Kills by Bear Management Area

The greatest proportion of grizzly bear mortalities occurred in BMA 4A (21%), 3A (18%), 2B (15%), and 4C (15%) (Tables 14 and 15). Legal harvest was the primary cause of mortality in BMAs 4A (90%), 4B (87%), 1 (76%), 4C (71%), 2B (67%), and 3A (67%) (Table 16, Figure 28). Other causes of mortality, which included illegal, problem wildlife, self-defense, Treaty

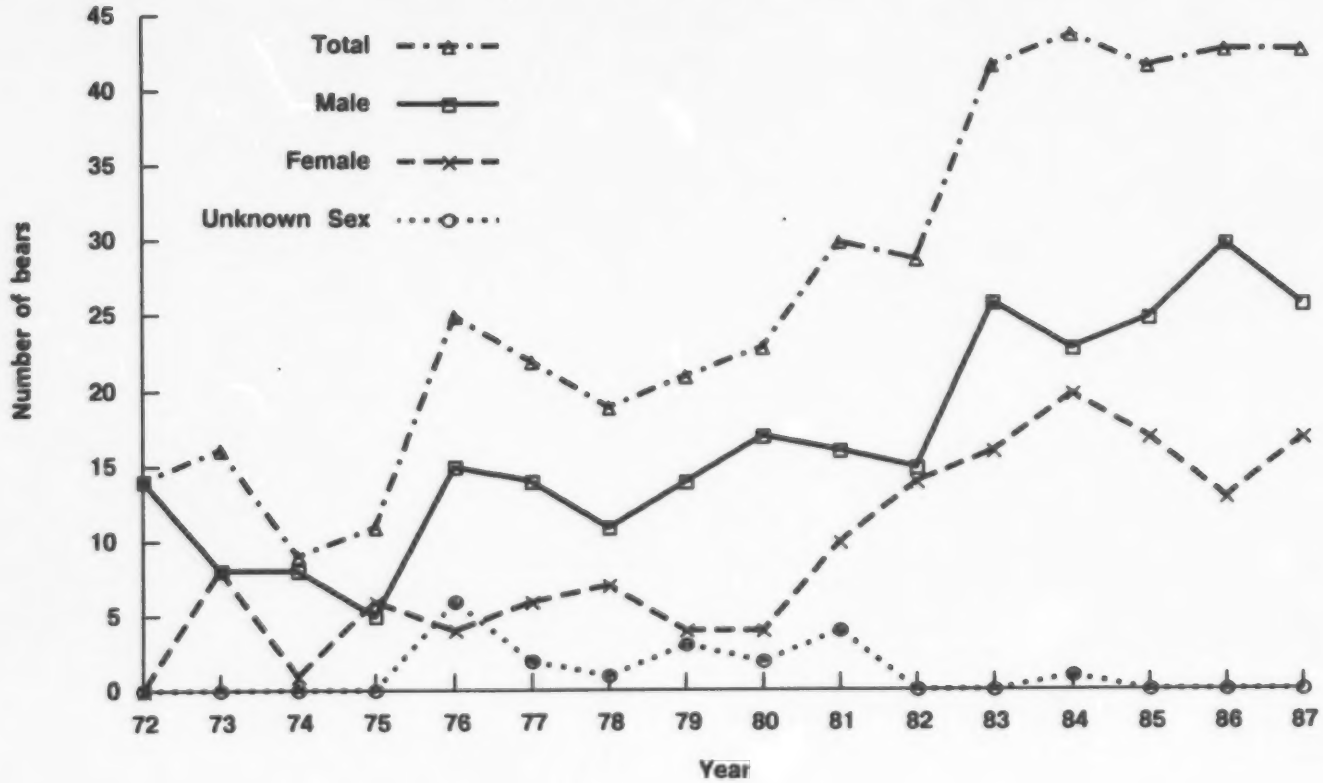

Figure 25. Summary of legal harvest of grizzly bears in Alberta by calendar year, 1972 - 87.

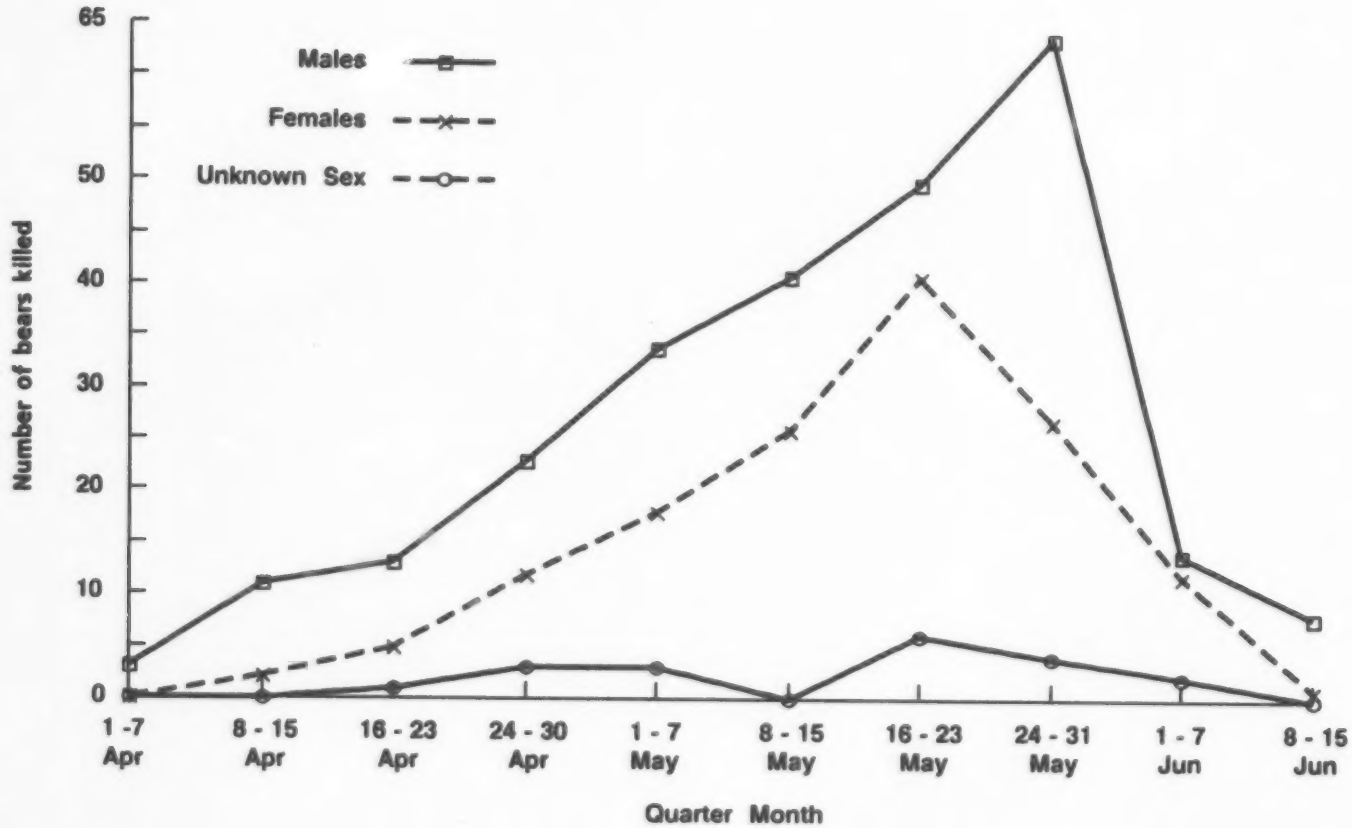

Figure 26. Quarter-monthly distribution of kills of grizzly bears in Alberta during the spring legal harvest, 1972 - 87.

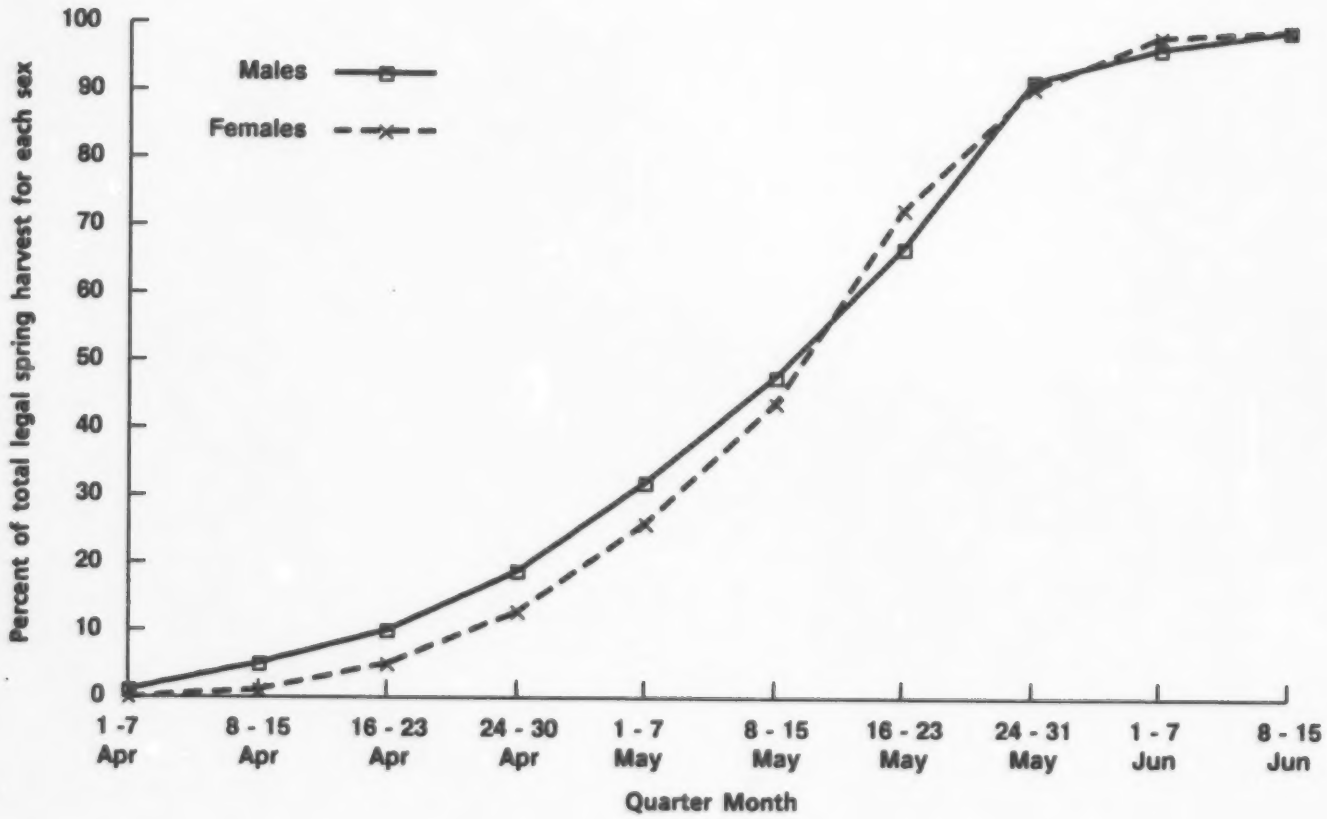

Figure 27. Cumulative percent quarter-monthly distribution of the spring legal harvest of male and female grizzly bears in Alberta, 1972 - 87.

Table 14. Numbers of grizzly bear mortalities by Bear Management Area and type in Alberta, 1972-87.

	TYPE OF KILL[a]							
BMA	LH	IL	PW	SD	TI	RE	AC	TOTAL
1	25	5	2	1	0	0	0	33
2A	9	4	5	0	1	0	1	20
2B	66	15	8	3	0	2	2	96
3A	76	11	6	13	1	4	3	114
3B	7	2	3	2	1	0	0	15
4A	122	3	3	2	3	0	3	136
4B	40	3	1	2	0	0	0	46
4C	65	16	4	6	0	0	1	92
5	1	4	1	4	0	1	0	11
6	12	8	1	6	3	0	1	31
7	6	7	12	1	5	0	0	31
8	0	0	1	0	0	0	0	1
13	1	1	2	0	0	0	1	5
410	0	0	0	1	0	0	0	1
16	3	0	0	0	0	0	0	3
99	0	1	0	0	0	0	0	1
TOTAL	433	80	49	41	14	7	12	636

[a]Type of Kill:

LH	Legal Harvest	TI	Treaty Indian
IL	Illegal Kill	RE	Research
PW	Problem Wildlife	AC	Accidental
SD	Self-defense		

Table 15. Numbers of grizzly bears in the total kill by Bear Management Area (BMA) in Alberta, 1972-87.

	YEAR																
BMA	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	TOTAL
1	1	1	2	1	1	3	0	1	1	5	3	6	3	1	3	1	33
2A	0	0	0	1	2	1	2	1	1	1	2	2	1	1	1	4	20
2B	1	0	2	3	5	6	6	4	5	6	11	7	10	9	10	11	96
3A	5	10	8	7	8	5	6	8	4	8	12	9	7	9	6	2	114
3B	1	0	1	0	1	1	1	1	1	2	1	2	1	0	0	2	15
4A	6	1	3	6	9	8	3	7	11	7	6	14	15	18	12	10	136
4B	2	1	1	2	2	3	4	1	3	2	2	0	6	5	6	6	46
4C	2	2	0	0	5	4	4	5	11	12	5	12	6	6	6	12	92
5	0	1	2	0	1	0	0	1	1	2	0	0	0	1	0	2	11
6	0	0	4	0	0	0	0	1	0	1	2	3	6	2	6	7	31
7	0	0	3	0	2	0	0	3	0	0	3	5	3	3	2	7	31
8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
13	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	3	5
410	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
16	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
99	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	18	17	26	21	38	32	27	33	38	46	48	60	59	55	51	67	636

Table 16. Number of bears in legal harvest by Bear Management Area (BMA) and calendar year in Alberta, 1972-87.

	YEAR																72	77	82	72-87
BMA	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	-76	-81	-86	TOTAL
1	1	1	1	1	0	3	0	0	1	2	1	6	3	1	3	1	4	6	14	25
2A	0	0	0	0	1	1	0	0	0	1	1	1	0	1	1	2	1	2	4	9
2B	1	0	1	2	2	4	3	3	2	5	5	4	9	7	8	10	6	17	33	66
3A	4	10	5	1	4	1	5	7	1	4	7	5	6	8	6	2	24	18	32	76
3B	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	2	3	1	7
4A	5	1	1	6	9	7	3	7	10	7	6	13	14	13	11	9	22	34	57	122
4B	2	1	1	1	2	3	4	1	2	1	2	0	3	5	6	6	7	11	16	40
4C	0	2	0	0	4	2	3	2	6	9	4	10	4	6	6	7	6	22	30	65
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
6	0	0	0	0	0	0	0	0	0	0	1	1	5	0	2	3	0	0	9	12
7	0	0	0	0	0	0	0	1	0	0	2	1	0	1	0	1	0	1	4	6
13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
16	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	2	1	0	3
TOTAL	14	16	9	11	25	22	19	21	23	30	29	42	44	42	43	43	75	115	200	433

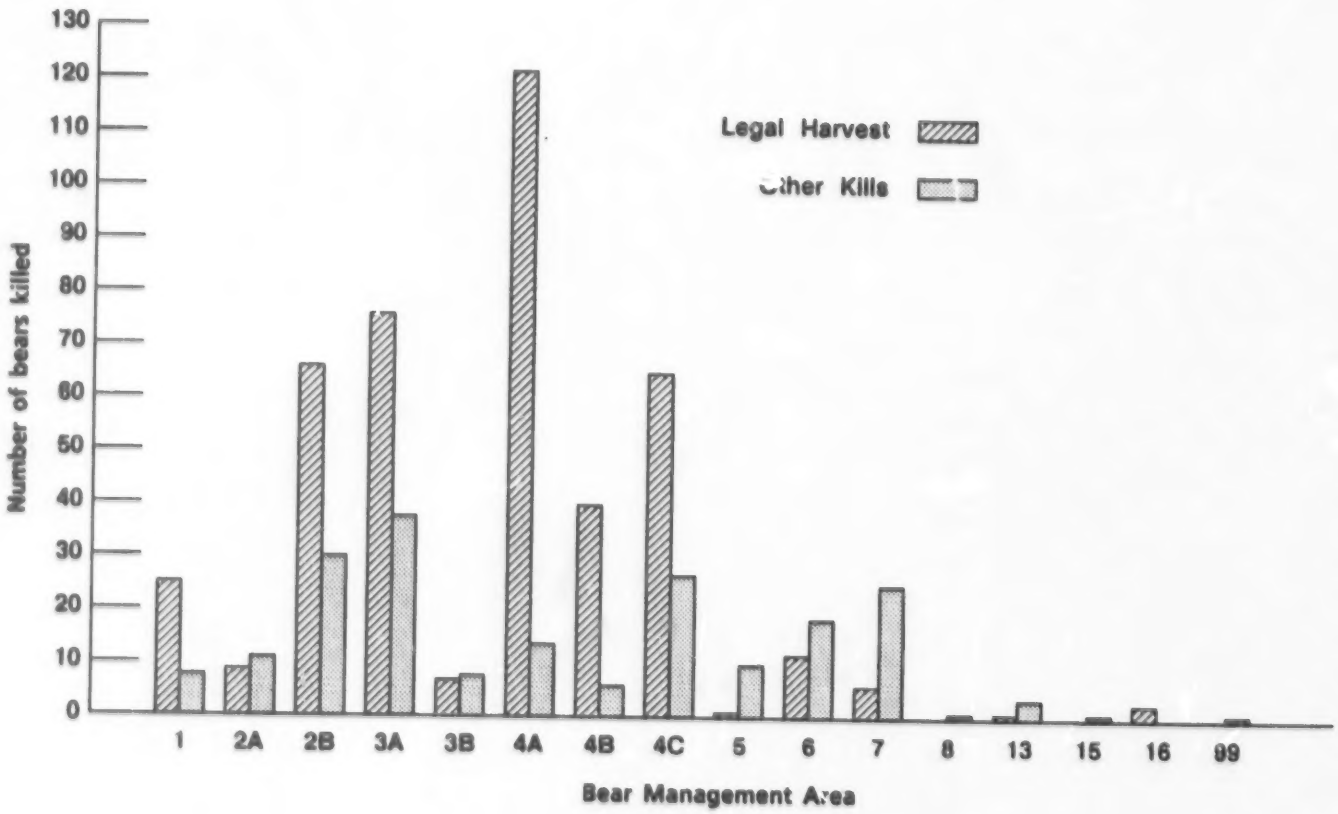

Figure 28. Summary of legal harvest and other kills by Bear Management Area, 1972 - 87.

Indian, research, and accidental kills, were the primary cause of mortality in BMAs 5 (91%), 7 (79%), 6 (61%), 3B (53%), and 2A (53%) (Figure 28). The greatest proportion of illegal kills occurred in BMAs 2B (19%), 4C (21%), 3A (14%), and 6 (10%) (Table 14). Most of the problem wildlife control kills were made in BMAs 7 (22%), 2B (18%), 2A (10%), and 3A (10%). The greatest proportion of self-defense kills occurred in BMAs 3A (32%), 4C (15%), 6 (15%), and 5 (10%). Seventy-one percent of the kills by Treaty Indians occurred in BMAs 4A, 6 and 7.

2.3.5.2 Timing of Legal Harvest by BMA

Spring 1972-87 harvest dates were pooled by sex within BMAs 2B, 3A, 4A, 4B, and 4C and the quarter-monthly distribution compared using a chi-square test for independence.

The distribution of kills of males and females did not vary significantly within BMAs 2B, 3A, 4A, 4B, and 4C ($P>0.05$). The data for males and females were then pooled within BMAs, and the spring harvest dates compared among BMAs using a chi-square test for independence. The quarter-monthly distribution of the total legal harvest varied significantly among BMAs ($P<0.001$) (Figure 29). Greater numbers of bears than statistically expected were harvested in April and early May in BMAs 3A and 4C, during the initial three-quarters of May in BMA 2B, during the last three-quarters of May and early June in BMA 4A, and early June in BMA 4B. Approximately 55% of the total legal harvest of bears in the more accessible BMAs 3A and 4C had occurred by 15 May (Figure 29) while only 35%-45% of the totals had been harvested by that date in the more remote BMAs 2B, 4A, and 4B. These data may reflect regional differences in emergence times of bears, general accessibility of areas due to road and snow conditions during the spring hunting season, and possibly client-booking preferences of guiding outfitters.

2.3.7 Current Status of Grizzly Bear Populations - Methodology

2.3.7.1 Allowable Mortality Rates

Populations of living organisms can sustain only a finite level of

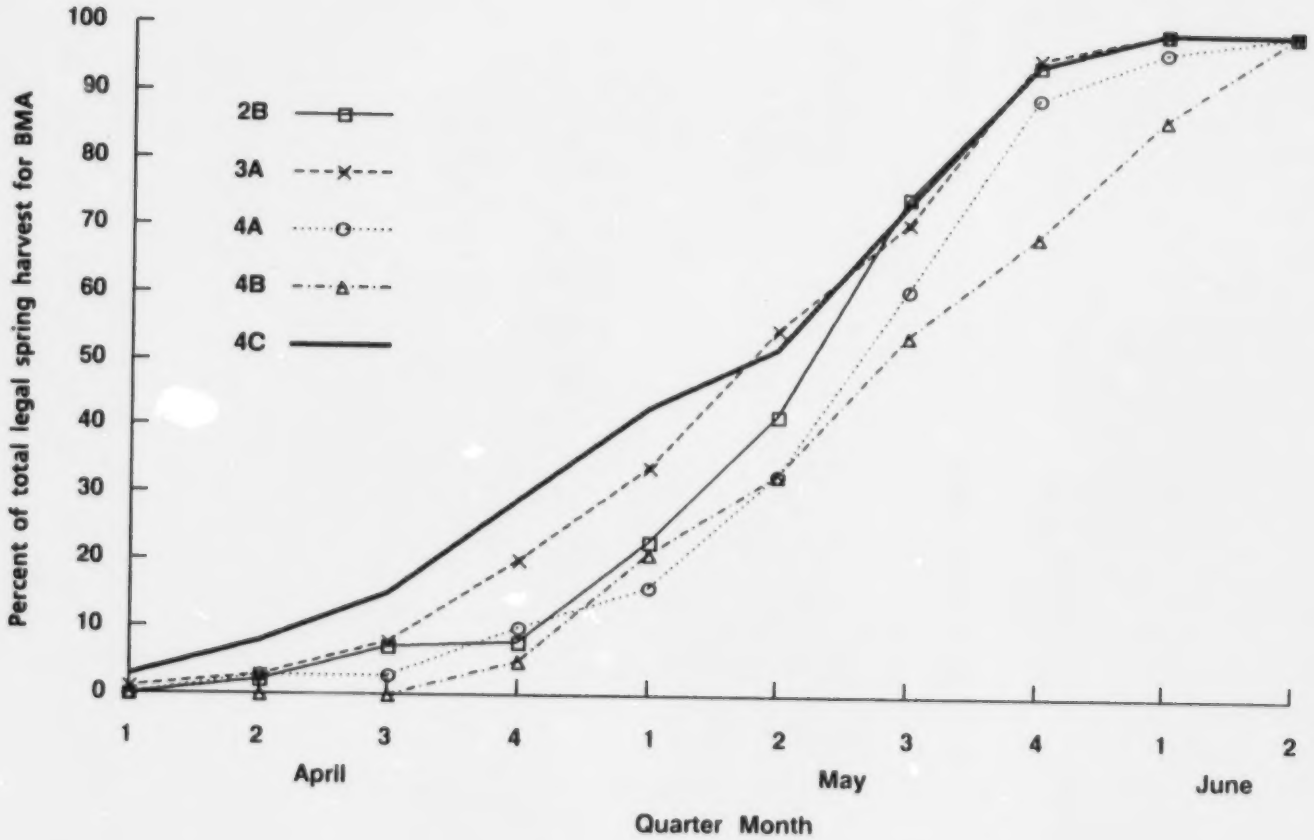

Figure 29. Cumulative percent quarter-monthly distribution of legal harvest of grizzly bears in Bear Management Areas (BMAs) 2B, 3A, 4A, 4B, and 4C.

mortality; mortality in excess of annual recruitment will lead to population decline. Allowable mortality is heavily dependent on reproductive performance, of which average age of first reproduction, litter size and reproductive interval are important measures. For black bears, with a natality rate of about 1.0 and first litters at three to five years of age, the maximum sustainable mortality rate is 16%-23% (Bunnell and Tait 1980, Lindzey et al. 1983, Kolenosky 1986). For less productive polar bears (Ursus maritimus) and grizzlies, maximum sustainable mortality is 8%-15% where first reproduction is three to nine years of age and average litters are 1.6-2.2 young every three or four years (Bunnell and Tait 1980, Taylor et al. 1987, Nagy et al. 1989).

Because natural mortality occurs in grizzly populations (see Section 2.2.5), man-caused mortality must be less than total mortality. Harris (unpubl.) calculated a maximum allowable man-caused mortality of 6.5% for the Northern Continental Divide Ecosystem (NCDE) population in northern Montana (assuming the 69% males in the total kill would continue). Dood et al. (1986) recommended a maximum total man-caused mortality rate (known and unreported) of 6% for the NCDE. In British Columbia, Tompa (1984) recommended that total man-caused mortality, including legal harvest, wounding losses and illegal kills, etc., must not exceed 5%. In the Yukon, where grizzly bears are relatively unproductive (Pearson 1975, Nagy et al. 1983a), Sidorowicz and Gilbert (1981) reported total man-caused mortality must be limited to 10.5% (5% of adults) and sport harvest to 2%-3% of adults, if hunting of females is not restricted.

The critical issue, in considerations of long-term, sustainable mortalities of bears is the sex ratio of the kill, and in particular, the effect on the number of adult females (Taylor et al. 1987). In British Columbia, grizzly managers strive for a sex ratio of 65:35 (males:females) in their annual harvest (R. Demarchi, F. Harper pers. comm. 1987). Allowable harvest importantly depends on the sex ratio. For example, allowable harvest from a population of 1000 polar bears would range between 15, if all bears killed were female, to 45, if two males were killed for every female [Polar Bear Technical Committee (I. Sterling) pers. comm.]. In that population of polar bears, no more than 1.6% of the female portion could be taken annually if the population was to sustain itself. Harvest could be calculated by the formula $H = N(0.015/Pf)$ where H = harvest,

N = population estimate and Pf = proportion of females in the harvest.

In general, harvest rates should allow for greater protection of females than males to maintain productive, harvestable grizzly bear populations. Bunnell and Tait (1985) suggested that the sex ratio of the harvest approaches 1:1 as hunting pressure increases, while Dood et al. (1986) suggested that an even sex ratio in the harvest is indicative of heavy hunting pressure. The sex ratio of annual mortalities, if skewed toward females, may have a negative influence on population productivity (Dood et al. 1986). Excessive removal of subadult females reduces future recruitment and productivity, while excessive removal of adult females reduces current productivity and future recruitment and productivity.

The recommendations of the above studies were used as a basis to evaluate the mortality data recorded during 1972-87, and to estimate the current status of grizzly bears within each BMA in Alberta. A population was considered to have been exploited at a sustainable level if the following held: (1) the annual total known man-caused mortality (TKMMs) had been stable for the past 10 years, (2) the density of bears/1000 km^2, on existing undisturbed lands required to support the annual TKMMs, was below or within the range of reported density estimates for ecologically similar areas, (3) the proportion of females in the running cumulative TKMMS or cumulative female mortality index (CFMI) did not deviate significantly above the expected proportion of 35% at year 1972+n, (4) there was minimal clumping of kill locations during the five-year period 1982-86, and (5) the kill status of the population indicated that the estimated average annual total kill (annual TKMMs +25% to compensate for wounding losses and unreported kills) approximated the estimated maximum allowable man-caused mortality (6% of population estimate) during the five-year period, 1982-86.

The required density of bears/1000 km^2 to support the annual TKMMs in each BMA was calculated as:

$$\text{Required Density} = \frac{\text{Annual TKMMs}/0.06}{\text{Area}/1000}$$

where 0.06 is the percent maximum allowable man-caused mortality and area (in km^2) is an estimate of the amount of existing undisturbed lands in each BMA. A population was considered to be overexploited if the density of

bears required to support the annual TKMMs exceeded the range of densities reported for ecologically similar areas.

The degree of deviation of observed from expected sex ratios in the running cumulative TKMMs were tested for each year (1972+n) using a chi-square goodness-of-fit test. The overall level of significance was tested at P=0.10, rather than the normal P=0.05, to ensure the likelihood of detecting any possible single differences (Gibbons 1985).

The proportion of males and females in the running cumulative TKMMs were examined because the sex ratio of the annual kill may not vary enough from the expected to be statistically different. However, when annual differences are accumulated over time (1972+n), the cumulative differences may be significant. The cumulative effect of minor, annual imbalances in the sex ratio of the total kill is limited; however, the effects of gross imbalances are carried forward in time. In general, a population was considered to be overexploited if the sex ratio of the cumulative total kill favored females over an extended period of time. This type of overharvest may cause a decline in the number of females in the standing population. In overexploited populations, conservative harvest rates or total protection may be required to allow for the recovery of females to desired numbers.

The spatial distribution of kill locations was examined to identify areas of potential overkill. Resident bears may be depleted in areas where kill sites are strongly clustered. A highly clustered distribution of female kill locations would be of particular concern. Long range dispersals of subadult females have not been reported in the literature, and as a result recolonization of areas that have been depleted of breeding females would be slow.

The methods used to derive population estimates to determine the kill status of bears in each BMA are provided in following sections.

2.3.6.2 Estimates of Populations Based on Densities

Zunino and Herrero (1972), Martinka (1974), Pearson (1975), Miller and Ballard (1982), and Tompa (1984) estimated population numbers using density data extrapolated from areas of intensive study. Reynolds and Hechtel (1980) reported that extrapolation of bear densities from areas and habitats of intensive study gave the best population estimates. Similarly, the

number of resident bears in each WMU and BMA in Alberta was estimated:

RESIDENT POPULATION = [LAND AREA (km^2) X (100 - (2 X MEASURED PERCENT DISTURBANCE))] X DENSITY ESTIMATE

The resulting estimates were considered as maximum post-emergence populations of grizzly bears in each WMU or BMA.

Density data were available for portions of the major habitat regions (Strong and Leggat 1981) occupied by grizzly bears in Alberta, including the northern and central montane/subalpine/alpine regions of Jasper and Banff national parks (Russell et al. 1978, W. Browne pers. comm. 1988), the southern montane/subalpine/alpine regions in Kananaskis Country (Carr 1989), the boreal mixedwood/boreal foothills regions south of Grande Prairie (Canadian Hunter unpublished), and, the boreal foothills/boreal uplands regions in the Swan Hills-Berland-Wildhay area (Nagy and Russell 1978, Nagy et al. 1989). Data on grizzly bear densities in the boreal northlands/boreal subarctic habitat regions were not available. The following densities were extrapolated to WMUs occurring in habitat regions that were similar to areas where studies had been conducted:

1) southern montane/subalpine/alpine - 14.7 bears/1000 km^2
2) northern and central montane/subalpine/alpine - 10 bears/1000 km^2
3) boreal mixedwood/boreal foothills - 7.4 bears/1000 km^2 (based on F. Harper and B. Fuhr pers comm.)
4) boreal foothills/boreal uplands - 4.6 bears/1000 km^2
5) boreal northlands/boreal subarctic - 4.0 bears/1000 km^2

Density values for northern and central montane/subalpine/alpine habitats on provincial lands (BMAs 4A-4C) were estimated at 5 bears/1000 km^2, or 50% of those reported for Banff and Jasper national parks, to reflect the effects of past harvest.

The types and extent of land surface disturbances within each WMU were determined using data provided in the Preliminary Wildlife Habitat Regions/Subregions Map of Alberta Extended Legend (Pedocan Land Evaluation Ltd. 1984) and Provincial Access maps. The area covered by habitat regions in each WMU was measured using a dot grid. The current vegetation cover and amount of land surface disturbance was determined using tabular data provided with the map. The impact of man-caused land surface disturbances on bear populations was considered to extend beyond the boundaries of the

actual surface areas disturbed because of the large home ranges and mobility of bears. As a result, this measured percentage of land surface disturbance was multiplied by two to estimate the total area of disturbance in each WMU.

2.3.6.3 Immigrant Bears

Immigration rates were estimated using total kill and translocation data recorded for WMUs 300 and 302. These areas do not support a substantial resident grizzly bear population because of intensive recreational, agricultural, and industrial activities. Bears were primarily considered to be transients, moving into the area on a seasonal basis from unhunted populations in Waterton Lakes National Park, Glacier National Park, USA and from hunted populations in southeastern British Columbia (McLellan 1984). Immigration rates were estimated by calculating the average number of bears killed or translocated/year from this area during the last five years (7.6 bears). For other BMAs, this rate was reduced in the analyses as the distance increased from an unhunted population to WMUs being considered.

2.3.6.4 Estimate of Allowable Total Kill and Harvest

The allowable annual total kill for each WMU was calculated as 6 % of the estimated total population number under the assumption that these bear populations were currently self-sustaining. In certain WMUs, where chronic losses of bears occur as a result of man-caused mortality factors other than legal harvest, the number of bears allocated for harvest should be reduced to compensate for those losses. As a result, the allowable annual legal harvest was estimated for each WMU as the allowable annual total kill multiplied by a ratio of the total legal harvest divided by the TKMMs for 1982-86. This ratio compensates for the differences in the magnitude of non-legal harvest-related mortalities among WMUs. The following equations were used:

ALLOWABLE ANNUAL TOTAL KILL = POPULATION ESTIMATE X 0.06

ALLOWABLE ANNUAL LEGAL HARVEST = ALLOWABLE ANNUAL TOTAL KILL X (TOTAL LEGAL KILL/TOTAL KILL)

For example, BMA 4A could sustain a total kill of 3 bears (6% of the estimated total population of 51 bears). During the period 1982-86, 88% of the bears killed were removed through legal harvest (57 bears in legal harvest divided by 65 bears in total kill). Therefore 88% of 3 bears or 2.6 bears on an annual average is allocated for legal harvest.

2.3.6.5 Kill Status

The kill status of a population in a WMU or BMA was determined by calculating first the difference between the average annual TKMMs or average annual net removals and the annual allowable total kill, and then the difference between the average annual legal kill and the annual allowable legal kill. The average annual TKMMs, legal harvest, and net removals were calculated for the period 1982-86 to reflect current rates of removal. Negative values indicated that annual TKMMs/net removals were less than the maximum allowable, while positive values indicated that the annual TKMMs/net removals were greater than allowable, so as to maintain stable self-sustaining populations.

2.3.7 Current Status of Grizzly Bear Populations - Evaluation by BMA

2.3.7.1 Provincial Summary

The estimated current number of grizzly bears, derived using reported estimates, is 575 bears on provincial lands in Alberta (Tables 17 and 18). This estimate includes 519 resident and 56 immigrant bears. In addition about 215 grizzly bears occur in Banff, Jasper, and Waterton Lakes national parks. The estimated average annual total kill (68.3 bears) and legal harvest (50.0 bears) exceeded the allowable total kill (34.5 bears) and legal harvest (25.3 bears) during the period 1982-86 (Table 18). These estimates suggest that grizzly bear populations have been overexploited in Alberta during those years.

2.3.7.2 BMA 1 (WMUs 520, 524, 528, 534, 536 and 538)

The greatest proportion of BMA 1 includes boreal mixedwood (57%),

Table 17. Summary of total kill, net translocations, net removals, total complaints and parameters used to estimate numbers of resident and immigrant bears within Bear Management Areas (BMAs).[a]

BMA	TOTAL KILL 1972-87	TOTAL KILL 1974-87	NET TRANS-LOCA-TIONS 1974-87	NET RE-MOVALS 1974-87	TOTAL COM-PLAINTS 1980-86	AREA (KM^2)	ANNUAL AVERAGE NUMBER: KILLS 1972-87	TRANS-LOCA-TIONS 1974-87	RE-MOVALS 1974-87	COM-PLAINTS 1980-86	BASAL DENSITY BEARS/1000 KM^2	PERCENT OF LAND SURFACE DISTURBED: MEA-SURED	EST. TOTAL	POPULATION ESTIMATE: RESI-DENT	IMMI-GRANT	TOTAL
1	33	31	5	26	19	144 407	2.1	0.4	1.9	2.7	0.6	0.07	0.14	82	0	82
2A	20	20	-10	30	47	33 323	1.3	-0.7	2.1	6.7	0.5	0.47	0.94	18	4	22
2B	96	95	7	88	30	25 706	6.0	0.5	6.3	4.3	5.0	0.13	0.25	127	0	127
3A	114	99	-6	105	42	24 688	7.1	-0.4	7.5	6.0	3.2	0.15	0.31	79	0	79
3B	15	14	4	10	28	12 644	0.9	0.3	0.7	4.0	2.0	0.24	0.48	26	0	26
4A	136	129	9	120	15	10 362	8.5	0.6	8.6	2.1	3.9	0.11	0.22	40	12	52
4B	46	43	8	35	27	6 089	2.9	0.6	2.5	3.9	4.6	0.04	0.08	28	6	34
4C	92	88	10	78	30	5 889	5.8	0.7	5.6	4.3	5.3	0.07	0.15	31	4	35
5	11	10	-1	11	73	3 455	0.7	-0.1	0.8	10.4	9.8	0.15	0.30	34	12	46
6	31	31	6	25	26	2 547	1.9	0.4	1.8	3.7	9.8	0.10	0.19	25	8	33
7	31	31	-30	61	84	11 581	1.9	-2.1	4.4	12.0	0.3	0.76	1.00	4	8	12
8	1	1	0	1	1	4 406	0.1	0.0	0.1	0.1	0.0	1.00	1.00	0	0	0
9	0	0	0	0	2	3 521	-	0.0	0.0	0.3	0.0	1.00	1.00	0	0	0
12	0	0	0	0	4	7 329	0.0	0.0	0.0	0.6	0.0	0.53	1.00	0	0	0
13	5	4	-3	7	13	22 826	0.3	-0.2	0.5	1.9	0.0	0.41	0.82	0	1	1
410	1	1	-1	2	10	8 015	0.1	-0.1	0.1	1.4	0.3	0.74	1.00	3	1	4
16	3	3	1	2	1	9 477	0.2	0.1	0.1	0.1	4.6	0.14	0.28	8	0	8
PLP	0	0	0	0	36	553	0.0	0.0	0.0	5.1	10.0	0.20	0.40	3	0	3
GRW	0	0	-	0	0	177	0.0	0.0	0.0	0.0	10.0	0.00	0.00	2	0	2
SFW	0	0	-	0	0	443	0.0	0.0	0.0	0.0	10.0	0.00	0.00	4	0	4
WGW	0	0	1	-1	0	487	0.0	0.1	-0.1	0.0	10.0	0.00	0.00	5	0	5
99	1	1	0	1	12	-	0.1	0.0	0.1	1.7	-	-	-	0	-	-
ALTA.	636	601	66	-	501									519	56	575
JASPER NATIONAL PARK																115
BANFF NATIONAL PARK																75
WATERTON LAKES NATIONAL PARK																25
GRAND TOTAL																790

[a] See Appendix VI-1 for WMU-specific data and legend.

Table 18. Summary of current total kill, legal harvest and translocation data, and kill status of grizzly bear populations by Bear Management Area (BMA) in Alberta.[a]

		TOTAL KILL 1982-86			LEGAL HARVEST 1982-86			TOTAL KILL AND TRANSLOCATIONS 1982-86			ALLOWABLE		AVERAGE ANNUAL			KILL STATUS		
BMA	POP. EST.	TOTAL KILL	% KILL FEMALE	% EST'D POP KILL /YEAR	TOTAL LEGAL HAR-VEST	% KILL FEMALE	% EST. LEGAL HAR-VEST /YEAR	NET TRANS-LOCA-TIONS	NET RE-MOVAL	% NET RE-MOVAL	TOTAL KILL /YEAR	LEGAL HAR-VEST /YEAR	TOTAL KILL /YEAR 1982 -86	LEGAL HAR-VEST 1982 -86	NET RE-MOVAL 1982 -86	TOTAL KILL	LEGAL HAR-VEST	NET RE-MOVAL
1	82	16	38	4	14	36	3	0	-16	-4	4.9	3.8	4.0	3.5	-3.2	-0.9	-0.3	-1.7
2A	22	7	20	6	4	25	4	0	-7	-6	1.3	1.0	1.8	1.0	-1.4	0.5	0.0	0.1
2B	127	47	48	7	33	48	5	1	-46	-7	7.6	5.1	11.8	8.3	-9.2	4.2	3.2	1.6
3A	79	43	32	11	32	38	8	-1	-44	-11	4.7	3.4	10.8	8.0	-8.8	6.0	4.6	4.1
3B	26	4	0	3	1	0	1	4	0	0	1.5	1.3	1.0	0.3	0.0	-0.5	-1.1	-1.5
4A	52	65	48	25	57	50	22	3	-62	-24	3.1	2.7	16.3	14.3	-12.4	13.2	11.6	9.3
4B	34	19	21	11	16	19	9	2	-17	-10	2.0	1.8	4.8	4.0	-3.4	2.8	2.2	1.4
4C	35	35	44	20	30	43	17	3	-32	-18	2.1	1.9	8.8	7.5	-6.4	6.7	5.6	4.3
5	46	1	-	0	0	-	-	0	-1	0	2.8	1.8	0.3	0.0	-0.2	-2.5	-1.8	-2.6
6	33	18	35	11	9	13	5	5	-13	-8	2.0	1.1	4.5	2.3	-2.6	2.5	1.2	0.6
7	12	16	23	27	4	25	7	-17	-33	-55	0.7	0.3	4.0	1.0	-6.6	3.3	0.7	5.9
8	0	1	0	-	0	-	-	0	-1	0	0.0	0.0	0.3	0.0	-0.2	0.3	0.0	0.2
9	0	0	-	-	0	-	-	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0	0	-	-	0	-	-	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1	1	-	-	0	-	-	0	-1	-20	0.1	0.1	0.3	0.0	-0.2	0.2	-0.1	0.1
410	4	0	-	-	0	-	-	0	0	0	0.2	0.2	0.0	0.0	0.0	-0.2	-0.2	-0.2
16	8	0	-	-	0	-	-	0	0	0	0.5	0.5	0.0	0.0	0.0	-0.5	-0.5	-0.5
PLPP	3				0			0	0	0		0.2			0.0		-0.2	0.0
GRW	2				0				0	0		0.1			0.0		-0.1	0.0
SFW	4				0				0	0		0.3			0.0		-0.3	0.0
WGW	5				0			0	0	0		0.3			0.0		-0.3	0.0
99	-	0						0	0	0		0.0			0.0		0.0	0.0
ALTA.[b]	575	273	39	10	200	41	7				34.5	25.3	68.3	50.0		33.8	24.7	

[a] See Appendix VI-2 for WMU-specific data and legend.

[b] Column totals do not equal cell totals due to rounding error.

followed by boreal northlands (22%), boreal subarctic (13%), and boreal foothills (9%) habitats (Appendix IV). The current vegetation cover is predominantly muskeg (50%), followed by deciduous- and coniferous-dominated mixed forests. Primary activities include clear-cutting, cultivation, and oil and gas development. Surface land disturbances occur on approximately 7% of the BMA, ranging from 3% to 15% of WMUs (Table 17).

BMA 1 provided 5% (33 bears) of the total 1972-87 provincial kill or 2.1 bears/year (Table 17), with 24 (75%) of those killed in WMU 524. Forty-eight percent of the total removals (16 or 3.2/year) occurred during 1982-86, with legal harvest the primary cause of mortality (2.8 bears/year). The annual kill peaked at five and six bears in 1981 and 1983, respectively (Figure 30). A subsequent decline in the total kill occurred. The densities of 0-3 bears/1000 km^2 required to support annual TKMMs during 1972-87 were below that of 4.6 bears/1000 km^2 reported for an ecologically similar area (Nagy et al. 1989) (Table 19, Figure 31). Overall, the proportion of males and females in the cumulative running total kill did not vary significantly from the desired ratio during 1972-87 ($P>0.10$) (Table 19). Minimal clumping of kill locations occurred (Figures 22 and 23).

The estimated total population is 82 bears (Table 18). The estimated average annual total kill (4 bears), legal harvest (3.5 bears), and net removals (3.2 bears) during 1982-86 were less than the estimated annual allowable total kill (4.9 bears) and legal harvest (3.8 bears) (Table 18). Bears were removed from this area at a sustainable level during 1982-86.

2.3.7.3 BMA 2A (WMUs 357, 358, 359, 521, 522 and 526)

The greatest proportion of BMA 2A includes boreal mixedwood (73%), followed by boreal foothills (27%) habitats (Appendix IV). The dominant current vegetation cover classes are cultivated (44%), deciduous-dominated (28%) and deciduous forests (10%), and muskeg (10%) (Appendix IV). Primary activities in this area include cultivation, pasturing of livestock, clear-cutting, oil and gas development, and urban facilities. Nearly half of the land base has been disturbed (48%), with the amount of land disturbance ranging from 40% to 58% within different WMUs.

BMA 2A provided 3% (19 bears) of the total 1972-87 provincial kill or 1.2 bears/year (Table 17). Thirty-seven percent of the total kill occurred

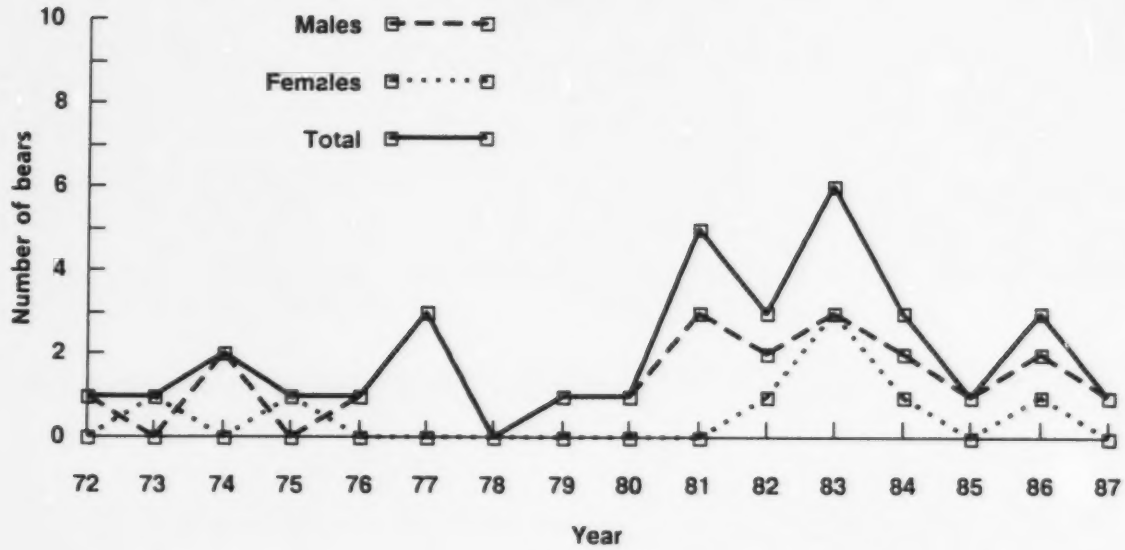

Figure 30. Annual total kill of grizzly bears in Bear Management Area (BMA) 1, 1972-87.

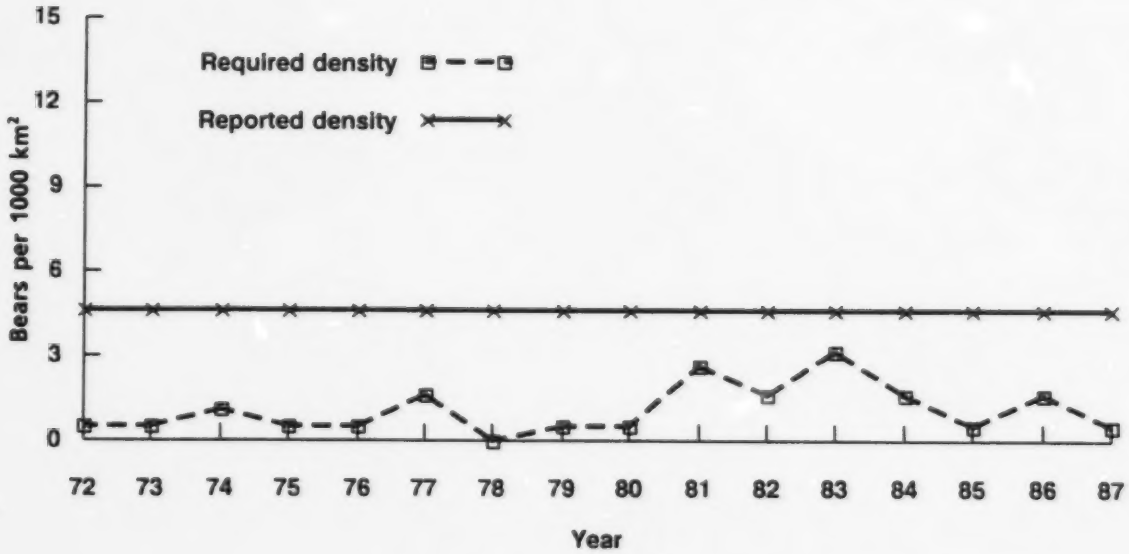

Figure 31. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 1 during 1972-87 and those densities reported for ecologically similar areas.

Table 19. Summary of mortality data for Bear Management Area 1.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	1	0	2	0	1	3	0	1	1	3	2	3	2	1	2	1
female	0	1	0	1	0	0	0	0	0	0	1	3	1	0	1	0
total	1	1	2	1	1	3	0	1	1	5	3	6	3	1	3	1
required density[a]	1	1	1	1	1	2	0	1	1	3	2	3	2	1	2	1
cumulative kill:																
female	0	1	1	2	2	2	2	2	2	2	3	6	7	7	8	8
male	1	1	3	3	4	7	7	8	9	14	16	19	21	22	24	25
percent female	0	50	25	40	33	22	22	20	18	13	16	24	25	24	25	24
CFMI[b]	0	0	0	0	0	-1	-1	-2	-2	-4	-4	-3	-3	-3	-3	-4

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

during 1982-86. Legal harvest was the primary cause of mortality during 1982-86 (57% or 0.8 bears/year). The annual TKMMs remained relatively constant at one to two bears during the last 10 years and consisted primarily of males (Figure 32). The densities of 0-4 bears/1000 km^2 required to support annual TKMMs during 1972-87 were below that of 4.6-9.6 bears/1000 km^2 reported for ecologically similar areas (Nagy and Russell 1979, Nagy et al. 1989, Harper pers. comm. 1987, Table 20, Figure 33). The proportion of males and females in the cumulative running total kill did not vary significantly from the desired ratio during 1972-87 ($P>0.10$). Kill locations occurred primarily in areas in close proximity to BMAs 1 or 2B, with most of the kill sites located in areas adjacent to the British Columbia-Alberta border in WMU 357 (Figure 23). This BMA does not support a substantial resident bear population because much of the land base has been developed for agriculture.

The estimated total population is 22 bears (Table 18). The estimated average annual total kill (1.8 bears), legal harvest (1 bear), and net removals (1.4 bears) during 1982-86 approximated the estimated allowable annual total kill (1.3 bears) and legal harvest (1 bear) (Table 18). Bears in this area were removed at the maximum sustainable level during 1982-86.

2.3.7.4 BMA 2B (WMUs 351, 354, and 356)

BMA 2B includes predominantly areas of boreal foothills (48%), boreal upland (34%), and boreal mixedwood (17%) habitats, with the western portion extending into subalpine (1%) habitats (Appendix IV). Dominant vegetation classes include deciduous-dominated (33%) and coniferous (25%) forests and muskeg (20%). The vegetation cover has been affected by human activity on approximately 10% of the BMA. Primary activities include cultivation, clear-cutting, oil and gas development, pasturing of livestock, surface mining, and urban facilities. Approximately 20% of the total land surface has been disturbed (Table 17), with most of that in the northern portions of WMUs 351, 354 and 356.

BMA 2B provided 15% (95 bears) of the total 1972-87 provincial kill or 5.9 bears/year (Table 17), with 88 (93%) of those killed in WMUs 354 and 356. Forty-nine percent of the total removals occurred during 1982-86; of those, 70% were removed through legal harvest.

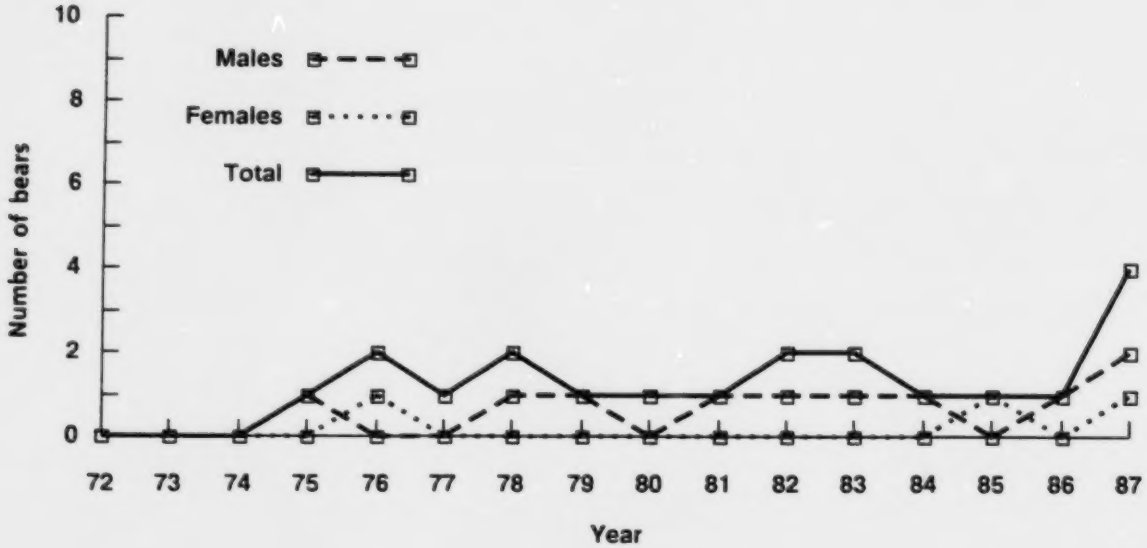

Figure 32. Annual total kill of grizzly bears in Bear Management Area (BMA) 2A, 1972-87.

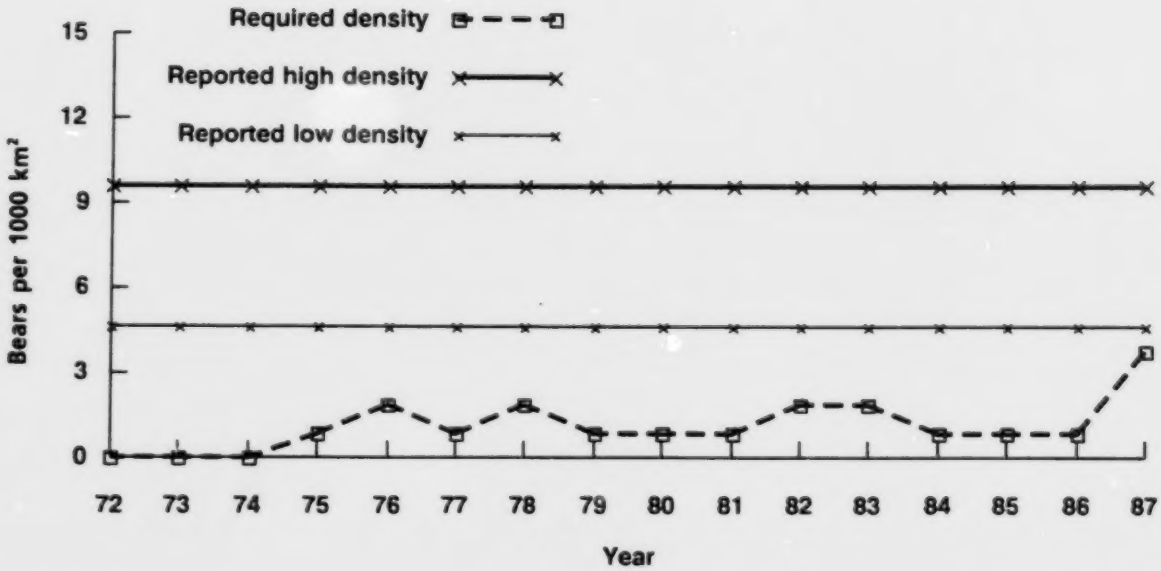

Figure 33. Densities of grizzly bears required to support total known man-caused mortalities (TKMMs) in bear management area (BMA) 2A during 1972-87 and those densities reported for ecologically similar areas.

Table 20. Summary of mortality data for Bear Management Area 2A.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	0	0	0	1	0	0	1	1	0	1	1	1	1	0	1	2
female	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1
total	0	0	0	1	2	1	2	1	1	1	2	2	1	1	1	4
required density[a]	0	0	0	1	2	1	2	1	1	1	2	2	1	1	1	4
cumulative kill:																
female	0	0	0	0	2	2	2	2	2	2	2	2	2	3	3	4
male	0	0	0	1	1	1	3	4	4	5	7	9	10	10	11	14
percent female	-	-	-	0	67	67	40	33	33	29	22	18	17	23	21	22
CFMI[b]	0	0	0	0	1	1	0	0	0	0	-1	-2	-2	-2	-2	-2

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

The annual TKMMs increased from three to six bears per year during 1974-81 to 7 to 11 bears during 1982-87 (Figure 34). Before 1981, the kill consisted primarily of males (50%-100%), while during 1981-83 the kill consisted primarily of females (64%-67%) (Table 21). The increase in the annual TKMMs during 1982-87 was sustained through an increase in the kill of females. Because the annual TKMMs were predominantly composed of males during 1972-80 and of females during 1981-87, the data were evaluated separately for those two periods. During 1972-80, the densities of 0-4 bears/1000 km^2 required to support annual TKMMs were below those of 4.6-9.6 bears/1000 km^2 reported for ecologically similar areas (Nagy and Russell 1978, Nagy et al. 1988, F. Harper pers. comm. 1987, Table 21, Figure 35). Significantly fewer females were removed from the population than expected by 1980. During 1981-87, the densities of bears required to support annual TKMMs increased to 4-8 bears/1000 km^2, but remained within the range of reported densities (Nagy and Russell 1978, Nagy et al. 1989, F. Harper pers. comm. 1987, Table 21, Figure 35). However, the cumulative kill of females was significantly greater than expected for this period. During the seven-year period 1981-1987, 11 more females than expected had been removed from the population suggesting that removal rates were excessive to the maintenance of stable resident populations in this area (Table 21). Clumping of kill sites of males and females occurred in the western and central portions of the BMA (Figure 23).

The estimated total population is 127 bears (Table 18). The estimated average annual total kill (11.8 bears), legal harvest (8.3 bears), and net removals (9.2 bears) for 1982-86 were greater than the estimated annual allowable total kill (7.6 bears) and legal harvest (5.1 bears) (Table 18). Bears were removed from this area at a rate which exceeded sustainable levels for a stable resident population during 1982-86.

2.3.7.5 BMA 3A (WMUs 344, 346, 350, and 352)

BMA 3A primarily includes areas of boreal foothills (48%), boreal upland (39%), and boreal mixedwood (12%) habitats, with the western portion including montane (1%) habitats. The dominant vegetation cover classes include mixed coniferous (23%), deciduous-dominated (22%), and coniferous (17%) forests and muskeg (17%) (Appendix IV). The vegetation cover has been affected by human activity on approximately 4% of the BMA. The primary

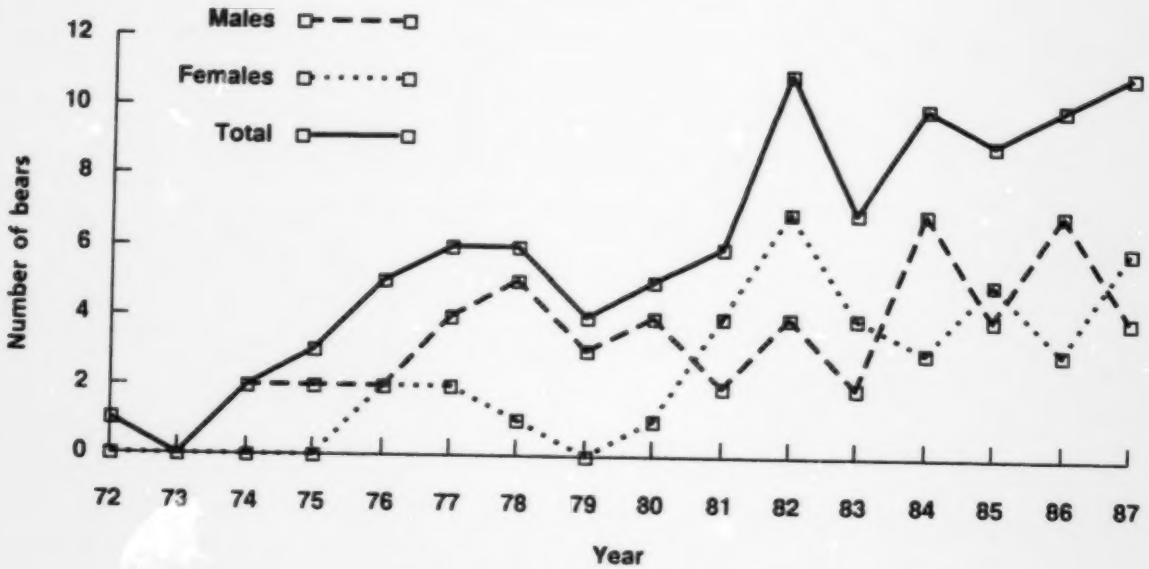

Figure 34. Annual total kill of grizzly bears in Bear Management Area (BMA) 2B, 1972-87.

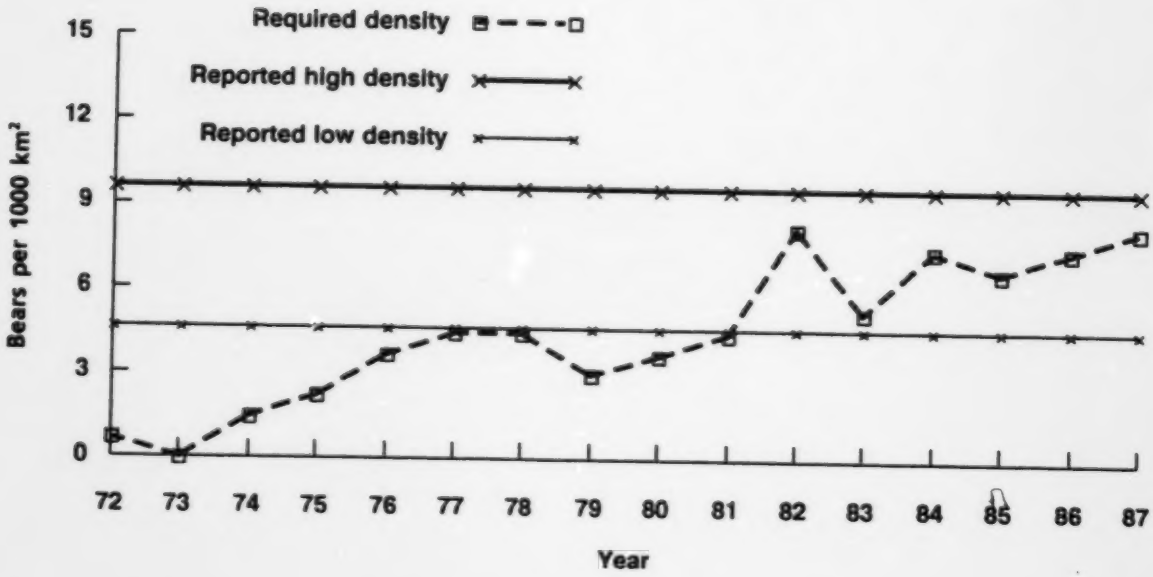

Figure 35. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 2B during 1972-87 and those densities reported for ecologically similar areas.

Table 21. Summary of mortality data for Bear Management Area 2B.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	1	0	2	2	2	4	5	3	4	2	4	2	7	4	7	4
female	0	0	0	0	2	2	1	0	1	4	7	4	3	5	3	6
total	1	0	2	3	5	6	6	4	5	6	11	7	10	9	10	11
required density[a]	1	0	1	2	4	4	4	3	4	4	8	5	7	7	7	8
cumulative kill:																
female	0	0	0	0	3	5	6	6	7	4	11	16	19	24	27	33
male	1	1	3	6	9	13	18	22	26	2	6	8	15	19	26	31
percent female	0	0	0	0	25	28	25	21	21	67	65	67	56	56	51	52
CFMI[b]	0	0	-1	-2	-1	-1	-3	-4	-5	2	5	7	7	9	8	11

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the year when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

Data used to evaluate cumulative kill and CFMI were summarized for the periods 1972-80 and 1981-87 to more accurately reflect changes in mortalities of females.

activities in the area include clear-cutting and oil and gas development, with some cultivation and pasturing of livestock. Land surface disturbances occur on approximately 18% of the BMA (Table 17).

BMA 3A provided 18% (113 bears) of the total 1972-87 provincial kill or 7.1 bears/year (Table 17), with the greatest number of kills occurring in WMU 350 (45 bears or 2.8/year), WMU 344 (30 bears or 1.9/year), and WMU 352 (26 bears or 1.6/year). Thirty-eight percent of the total removals (43 bears) occurred during 1982-86, with legal harvest the primary cause of mortality (74%).

The annual TKMMs declined from 8 to 10 bears to four bears during 1973-80 (Figure 36). The sex ratio of the kill varied from 100% males to 80% females from year to year during that period. The annual TKMMs increased following that period, peaking in 1982 at 11 bears. A subsequent decline in the annual TKMMs of kills to two bears had occurred by 1987. The kill during 1981-85 was sustained primarily by removal of males (64%-83% of annual kill, Figure 36). During 1986-87, the kill declined from six to two bears, with the sex ratio of the kill shifting to 50% and 100% females, respectively. The total kill in 1987 was the lowest recorded during the last 16 years. Although the densities of 4-10 bears/1000 km^2 required to support annual TKMMs during 1972-87 were predominantly within the range of 4.6-9.6 bears/1000 km^2 reported for ecologically similar areas (Nagy and Russell 1978, Nagy et al. 1989, F. Harper pers. comm. 1987, Table 22, Figure 37), the population has likely been harvested at the maximum rate since 1972. The cumulative kill of females in this area, although not significantly greater than expected, is of concern (Table 22, Figure 37). Clustering of kill locations occurred in the western and eastern portions of the BMA (Figure 23).

The estimated total population is 79 bears (Table 18). The estimated average annual total kill (10.8 bears), legal harvest (8.0 bears), and net removals (8.8 bears) for 1982-86 were greater than the estimated annual allowable total kill (4.7 bears) and legal harvest (3.4 bears) (Table 18). Bears were removed from this area at a rate which exceeded sustainable levels for a stable resident population during 1982-86.

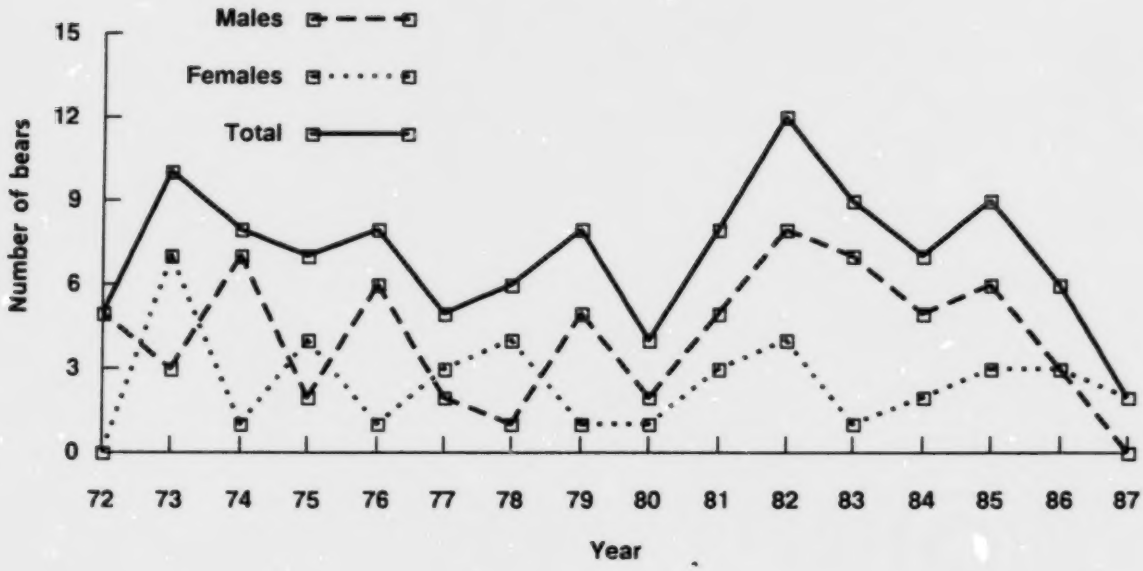

Figure 36. Annual total kill of grizzly bears in Bear Management Area (BMA) 3A, 1972-87.

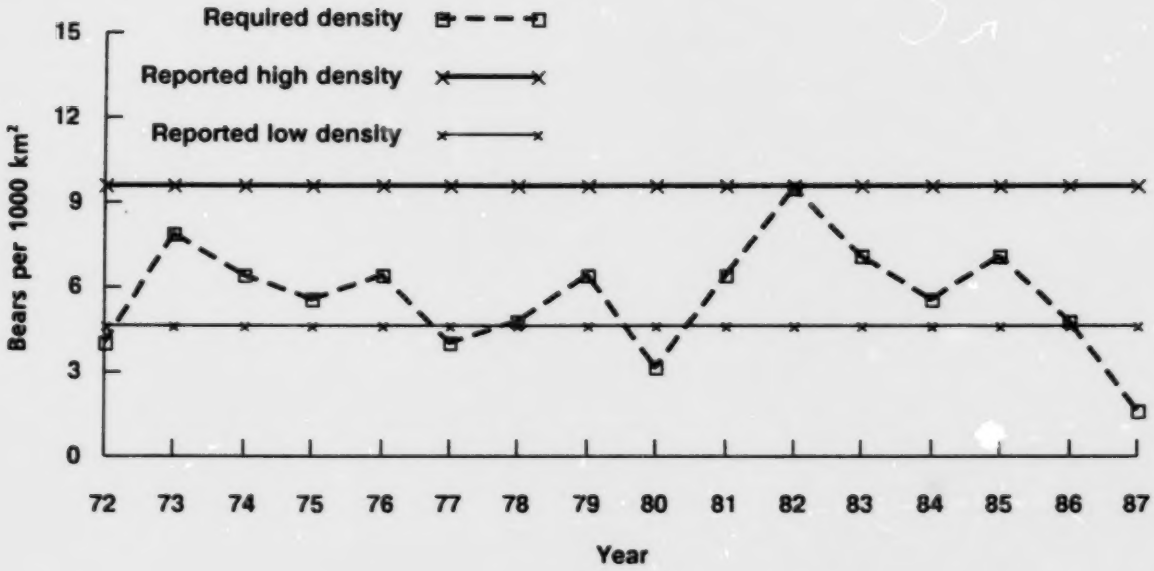

Figure 37. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 3A during 1972-87 and those densities reported for ecologically similar areas.

Table 22. Summary of mortality data for Bear Management Area 3A.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	5	3	7	2	6	2	1	5	2	5	8	7	5	6	3	0
female	0	7	1	4	1	3	4	1	1	3	4	1	2	3	3	2
total	5	10	8	7	8	5	6	8	4	8	12	9	7	9	6	2
required density[a]	4	8	6	6	6	4	5	6	3	6	10	7	6	7	5	2
cumulative kill:																
female	0	7	8	13	14	17	22	23	24	27	31	32	34	37	40	42
male	5	8	15	17	24	26	27	34	37	42	50	58	63	69	72	72
percent female	0	47	35	43	37	40	45	40	39	39	38	36	35	35	36	37
CFMI[b]	-2	2	0	2	1	2	4	3	3	3	3	1	0	0	1	3

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

2.3.7.6 BMA 3B (WMUs 326, 328, 330, 339, 340, 342, and 429)

BMA 3B primarily includes areas of boreal foothills (68%) and boreal upland (31%) habitats, with portions extending into boreal mixedwood (1%), subalpine (<1%), and alpine (<1%) habitats (Appendix IV). The dominant vegetation cover classes include coniferous (43%), mixed coniferous, and deciduous-dominated mixed (14%) forests, and muskeg (17%). Approximately 2% of the vegetation is cultivated. Primary activities in the area include clear-cutting and oil and gas development, with some cultivation, surface mining, pasturing of livestock and urban facilities. Approximately 15% of the land surface has been disturbed (Table 17), ranging from 10% to 26% within different WMUs.

BMA 3B provided 2% (15 bears) of the total 1972-87 provincial kill or 0.9 bears/year, with 4 (27%) of those removed during 1982-86 (Table 18). The densities of 0-3 bears/1000 km^2 required to support annual TKMMs during 1972-87 were below those of 4.6-9.6 bears/1000 km^2 reported for ecologically similar areas (Nagy and Russell 1978, Nagy et al. 1989, F. Harper pers. comm. 1987, Table 23, Figure 39). No female grizzly bears have been killed in this area during the last 16 years (Figure 38), suggesting that this population primarily consists of transient or resident males. Most of the bears were killed through causes other than legal harvest (53%).

The estimated total population is 26 bears (Table 18). The estimated average annual total kill (1 bear) and legal harvest (0.3 bears) for 1982-86 were less than the estimated annual allowable total kill (1.5 bears) and legal harvest (1.3 bears) (Table 18). Bears were removed from this area at a sustainable rate. The total kill in this area may be sustained by immigration from adjacent areas.

2.3.7.7 BMA 4A (WMUs 439, 440, 441, 442, 444, 445, and 446)

BMA 4A primarily includes areas of subalpine (45%) and alpine (27%) habitats, with the northern and eastern portions extending into montane (2%) and boreal upland (27%) habitats (Appendix IV). The dominant vegetation cover classes include coniferous (37%), conifer-dominated mixed (9%), deciduous (8%), and deciduous-dominated mixed (6%) forests and shrub-dominated mixed grass/forb (15%). Approximately 24% of the area is

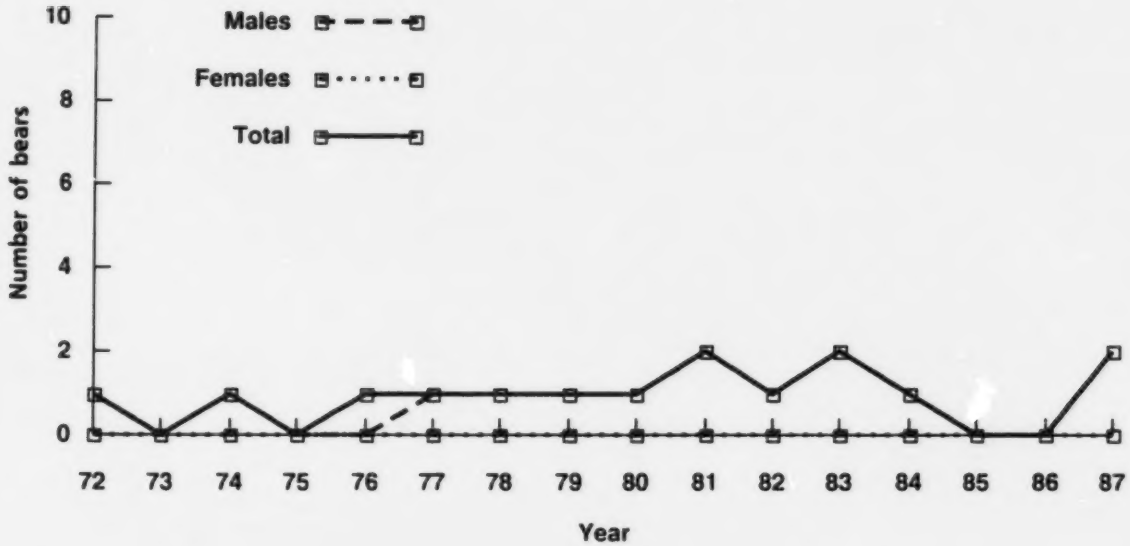

Figure 38. Annual total kill of grizzly bears in Bear Management Area (BMA) 3B, 1972-87.

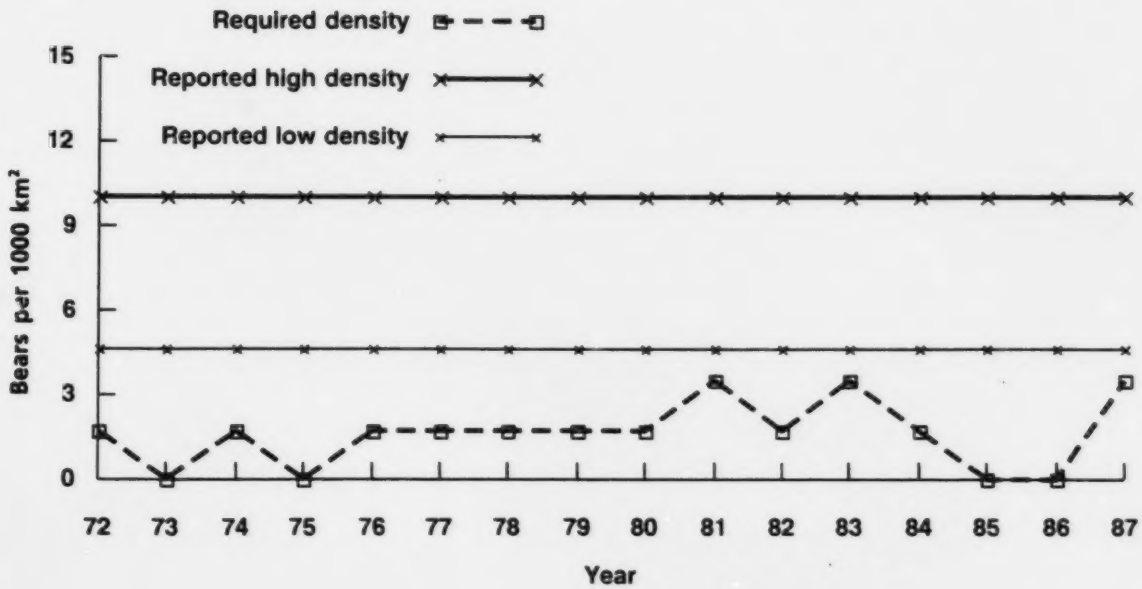

Figure 39. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 3B during 1972-87 and those densities reported for ecologically similar areas.

Table 23. Summary of mortality data for Bear Management Area 3B.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	1	0	1	0	0	1	1	1	1	2	1	2	1	0	0	2
female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total	1	0	1	0	1	1	1	1	1	2	1	2	1	0	0	2
required density[a]	2	0	2	0	2	2	2	2	2	3	2	3	2	0	0	3
cumulative kill:																
female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
male	1	1	2	2	2	3	4	5	6	8	9	11	12	12	12	14
percent female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CFMI[b]	0	0	-1	-1	-1	-1	-1	-2	-2	-3	-3	-4	-4	-4	-4	-5

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

classified as nonvegetated mineral. Land surface disturbances, occurring on the northern and eastern portions of the BMA, primarily include surface mining and clear-cutting. Oil and gas development and urban facilities occur to a lesser degree. Approximately 3% of the land surface has been disturbed (Table 17).

BMA 4A provided 21% of the total 1972-87 provincial kill or 8.5 bears/year (Table 17), with the greatest proportion of those killed in WMUs 440 (55 bears), 446 (23 bears), and 442 (21 bears). Forty-eight percent of the total removals (65 bears) occurred during 1982-86, with legal harvest being the primary cause of mortality (86%).

The annual TKMMs has generally increased from 1972 to 1987 (Figure 40). Three major peaks in the TKMMs occurred, including 6-9 bears in 1975-77, 7-11 bears in 1979-81, and 14-18 bears in 1983-85. Increases in the TKMMs during the first two peaks were primarily sustained by an increase in the removal of males, while the increase during the third peak was sustained by an increase in the removal of males and females (Figure 40). Because the annual TKMMs were predominantly composed of males during 1972-80 and of females during 1981-87, the data were evaluated separately for those two periods. During 1972-80, the densities of 2-20 bears/1000 km^2 required to support the annual TKMMs were predominantly at or above the maximum values of 9.8-11.7 bears/1000 km^2 reported for an ecologically similar area (Russell et al. 1979) (Table 24, Figure 41). The proportion of females and males in the cumulative known kill did not deviate significantly from the expected ratio during that period. During 1981-87, the densities of bears required to support annual TKMMs increased to 11-33 bears/1000 km^2, with those values ranging from levels at or up to 2.8 times greater than maximum densities reported for ecologically similar areas (Russell et al. 1979) (Table 24, Figure 41). The proportion of females in the cumulative kill was significantly greater than expected for this period. During the seven-year period 1981-1987, 11 more females than expected had been removed from the population suggesting that removal rates were excessive to maintenance of stable resident populations in this area (Table 24). Clumping of kill locations of males and females occurred throughout the central and eastern portion of the BMA (Figure 23).

The estimated total population is 52 bears (Table 18). The estimated average annual total kill (16.3 bears), legal harvest (14.3 bears), and net

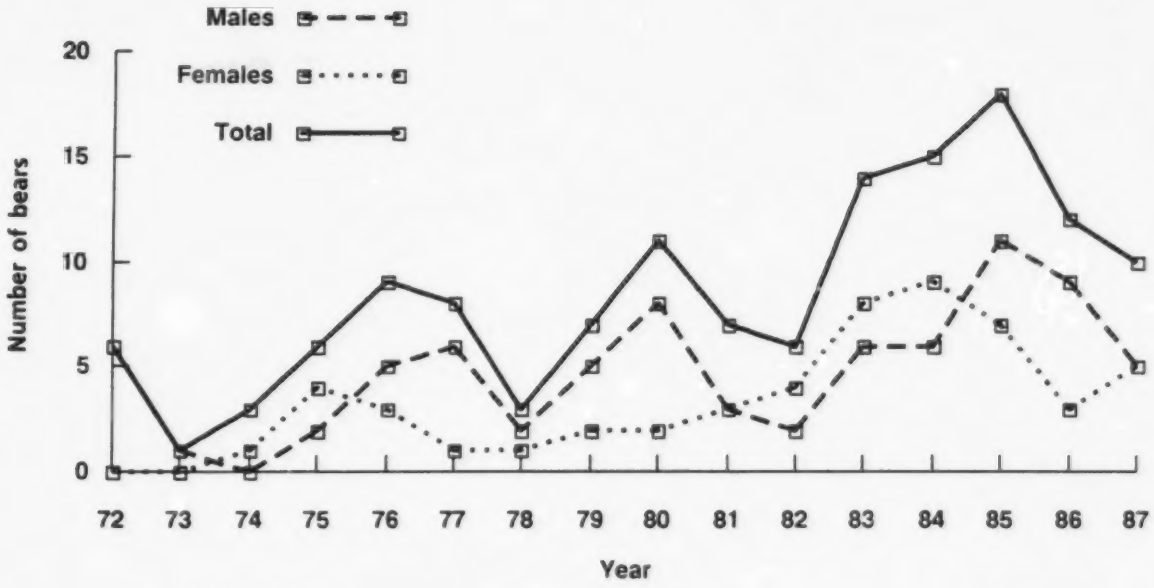

Figure 40. Annual total kill of grizzly bears in Bear Management Area (BMA) 4A, 1972-87.

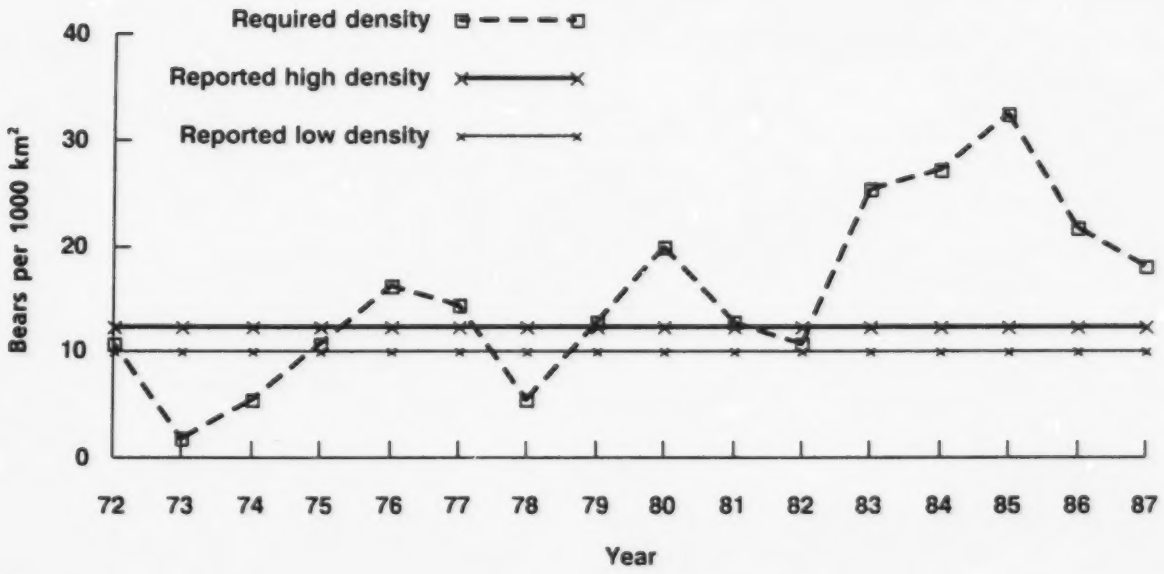

Figure 41. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 4A during 1972-87 and those densities reported for ecologically similar areas.

Table 24. Summary of mortality data for Bear Management Area 4A.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	6	1	0	2	5	6	2	5	8	3	2	6	6	11	9	5
female	0	0	1	4	3	1	1	2	2	3	4	8	9	7	3	5
total	6	1	3	6	9	8	3	7	11	7	6	14	15	18	12	10
required density[a]	11	2	5	11	16	14	5	13	20	13	11	25	27	33	22	18
cumulative kill:																
female	0	0	3	7	10	12	13	15	17	4	8	16	25	32	35	40
male	6	7	7	9	15	21	23	28	37	4	6	12	18	29	38	43
percent female	0	0	30	44	40	36	36	35	31	50	57	57	58	52	48	48
CFMI[b]	-2	-2	-1	1	2	0	0	-1	-2	1	3	6	10	11	9	11

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

Data used to evaluate cumulative kill and CFMI were summarized for the periods 1972-80 and 1981-87 to more accurately reflect changes in mortalities of females.

removals (12.4 bears) during 1982-86 exceeded the estimated annual allowable total kill (3.1 bears) and legal harvest (2.7 bears) (Table 18). Bears were removed from this area at a rate which exceeded sustainable levels for a stable resident population during 1982-86. Past removals may have been partially sustained by immigration of bears from Jasper National Park and British Columbia.

2.3.7.8 BMA 4B (WMUs 430, 432, 434, 436, 437 and 438)

BMA 4B primarily includes areas of boreal upland (49%), subalpine (27%), alpine (20%), and montane (2%) habitats (Appendix IV). The dominant vegetation cover classes include coniferous (53%) and conifer-dominated mixed (10%) forests, and shrub-dominated mixed grass/forb (15%). Approximately 19% of the BMA is classified as nonvegetated mineral. Primary activities include clear-cutting, oil and gas development, and surface mining. Approximately 4% of the land surface has been disturbed (Table 17).

BMA 4B provided 7% (46 bears) of the total 1972-87 provincial kill or 2.9 bears/year (Table 17), with the greatest proportion killed in WMU 438 (20 bears), 434 (10 bears), and 432 (8 bears). Forty-one percent of the total removals (19 bears) occurred during 1982-86, with legal harvest being the primary cause of mortality for those bears (84%).

The annual TKMMs ranged from 1-4 bears during 1972-83, and increased to five to six bears in 1984-87 (Figure 42). The kill in this area was sustained primarily by the removal of males during 1972-87, with females constituting 0%-33% of the annual TKMMs during much of that period. The densities of 0-9 bears/1000 km^2 required to support annual TKMMs during 1972-83 were predominantly below those of 9.8-11.7 bears/1000 km^2 reported for an ecologically similar area (Russell et al. 1979) (Table 25, Figure 43). During 1984-87, the densities of 14-17 bears/1000 km^2 were 1.2-1.5 times greater than maximum reported densities, suggesting that removal rates were excessive to maintenance of stable populations in this area. However, fewer females than expected have been removed from the area (Table 25). Kill sites were clustered in the extreme northern and southern portions of the BMA (Figure 23).

The estimated total population is 34 bears (Table 18). The estimated average annual total kill (4.8 bears), legal harvest (4 bears), and net

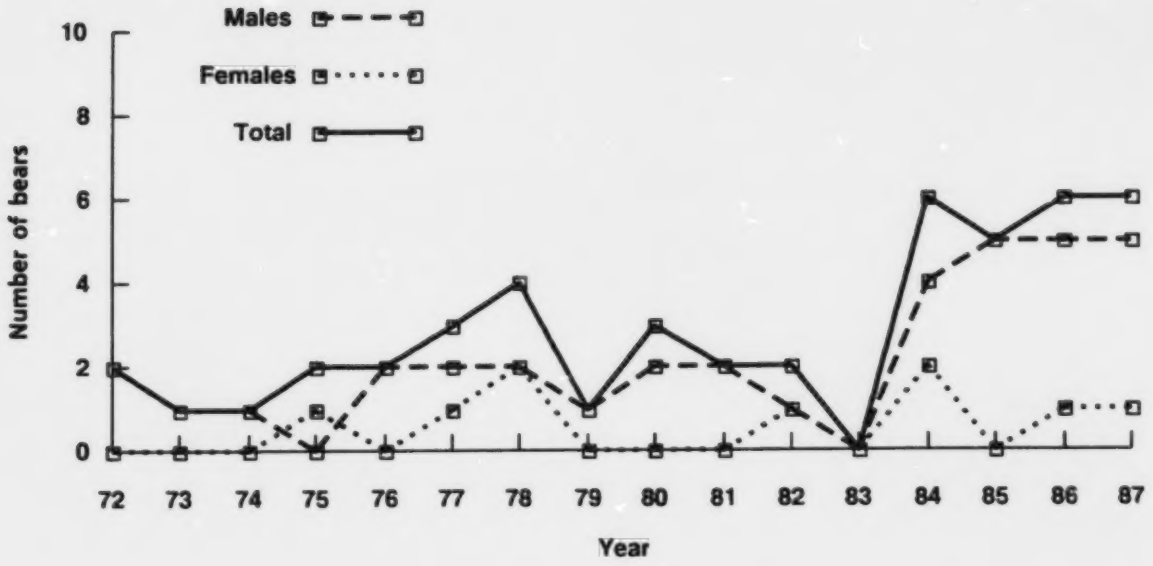

Figure 42. Annual total kill of grizzly bears in Bear Management Area (BMA) 4B, 1972-87.

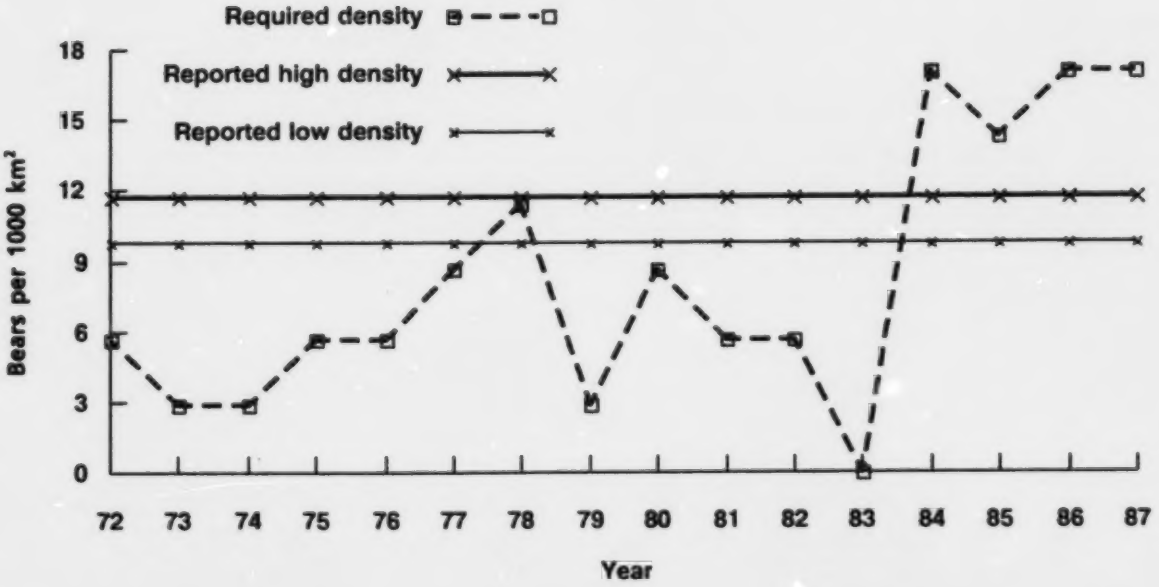

Figure 43. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 4B during 1972-87 and those densities reported for ecologically similar areas.

Table 25. Summary of mortality data for Bear Management Area 4B.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	2	1	1	0	2	2	2	1	2	2	1	0	4	5	5	5
female	0	0	0	1	0	1	2	0	0	0	1	0	2	0	1	1
total	2	1	1	2	2	3	4	1	3	2	2	0	6	5	6	6
required density[a]	6	3	3	6	6	9	11	3	9	6	6	0	17	14	17	17
cumulative kill:																
female	0	0	0	2	2	3	5	5	5	5	6	6	8	8	9	10
male	2	2	3	4	4	6	8	10	11	14	16	17	17	21	26	31
percent female	0	0	0	33	25	27	33	31	26	24	26	26	28	24	23	22
CFMI[b]	-1	-1	-1	0	-1	-1	0	-1	-2	-2	-2	-2	-2	-4	-5	-6

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

removals (3.4 bears) during 1982-86 exceeded the estimated annual allowable total kill (2 bears) and legal harvest (1.8 bears) (Table 18). Bears were removed from this area at a rate which exceeded levels required to maintain a stable resident population during 1982-86. Past removals may have been partially sustained by immigration of bears from Banff and Jasper national parks.

2.3.7.9 BMA 4C (WMUs 316, 318, 412, 414, 416, 418, 420, 422, 426 and 428)

BMA 4C primarily includes areas of boreal upland (40%), subalpine (27%), and alpine (20%) habitats, with the northern and eastern portions extending into boreal foothills (7%) and montane (6%) habitats (Appendix IV). The dominant vegetation cover classes include coniferous (52%), conifer-dominated mixed (8%), and deciduous (7%) forests, and shrub-dominated grass/forb (12%). Approximately 18% of the BMA is classified as nonvegetated mineral. The primary activities in the areas include clear-cutting, and oil and gas development. Approximately 8% of the land surface has been disturbed (Table 17).

BMA 4C provided 15% (92 bears) of the total 1972-87 provincial kill or 5.8 bears/year (Table 17), with the greatest numbers killed in WMUs 412 (14 bears), 316 (13 bears), 318 (15 bears), and 416 (11 bears). Thirty-eight percent of the total kill occurred during 1982-86, with legal harvest the primary cause of mortality (86%).

The annual TKMMs ranged from 2-5 during 1972-79, increased to 11-12 during 1980-83, decreased to 6 bears during 1984-85, and then increased to 12 bears in 1987 (Figure 44). The increases in annual TKMMs during 1979-83 were primarily sustained by an increase in the removal of males (67%-100% of annual kill), while that during 1984-85 and 1987 were sustained by an increase in the kill of females (67% of annual kill) (Table 26). The densities of bears required to support annual TKMMs, during the last 12 years of the period 1972-87, ranged from 12-37 bears/1000 km^2, which were up to 2.9 times greater than the maximum densities reported for an ecologically similar area (8.3-12.7 bears/1000 km^2) (W. Browne, 1988, pers. comm.) (Table 26, Figure 45). With the exception of the period 1984-87, annual mortalities consisted primarily of males. The high density of bears required to support annual TKMMs, and the increase in the proportion of

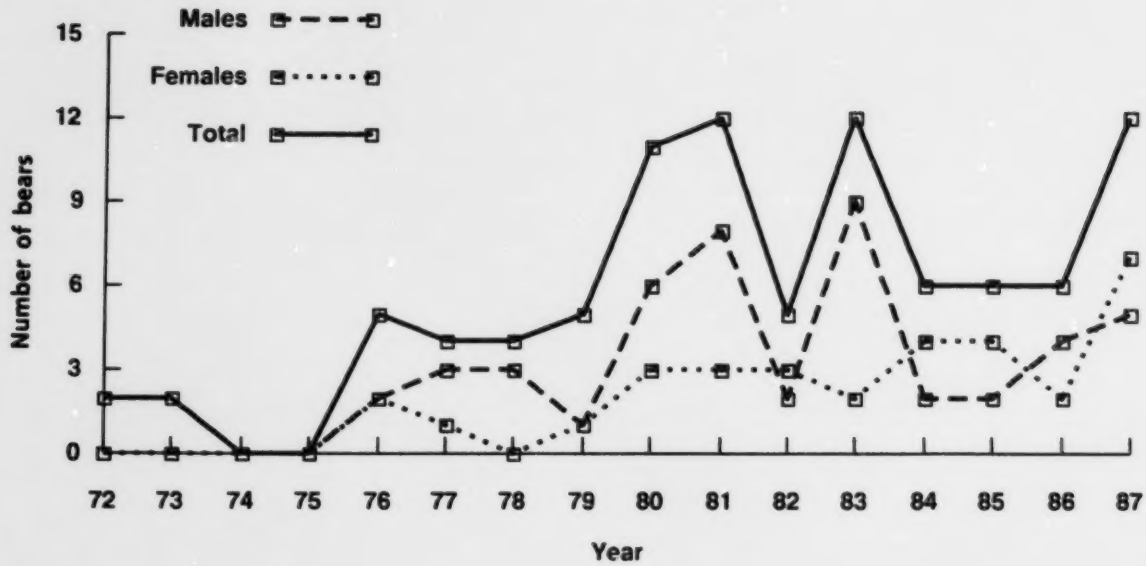

Figure 44. Annual total kill of grizzly bears in Bear Management Area (BMA) 4C, 1972-87.

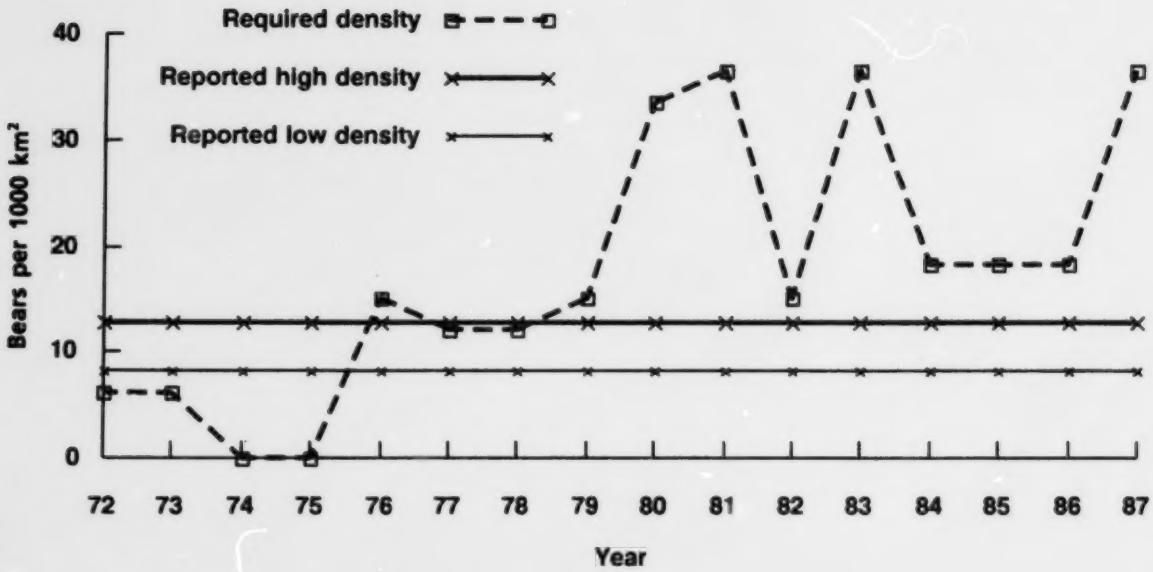

Figure 45. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 4C during 1972-87 and those densities reported for ecologically similar areas.

Table 26. Summary of mortality data for Bear Management Area 4C.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	2	2	0	0	2	3	3	1	6	8	2	9	2	2	4	5
female	0	0	0	0	2	1	0	1	3	3	3	2	4	4	2	7
total	2	2	0	0	5	4	4	5	11	12	5	12	6	6	6	12
required density[a]	6	6	0	0	15	12	12	15	33	37	15	37	18	18	18	37
cumulative kill:																
female	0	0	0	0	3	4	4	6	10	13	16	18	22	26	28	35
male	2	4	4	4	7	10	14	16	23	32	34	44	46	48	52	57
percent female	0	0	0	0	30	29	22	27	30	29	32	29	32	35	35	38
CFMI[b]	-1	-1	-1	-1	-1	-1	-2	-2	-2	-3	-2	-4	-2	0	0	3

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the year when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

females in the annual TKMMs during recent years, suggests that removal rates were excessive to maintenance of stable resident populations in this area (Table 26, Figure 45). Clumping of kill sites occurred in the southern half of the BMA (Figure 23).

The estimated total population is 35 bears (Table 18). The estimated average annual total kill (8.8 bears), legal harvest (7.5 bears), and net removals (6.4 bears) during 1982-86 exceeded the estimated allowable annual total kill (2.1 bears) and legal harvest (1.9 bears) (Table 18). Bears were removed from this area at a rate which exceeded a sustainable level for a stable resident population. Those rates may have been partially sustained by immigration from Banff National Park.

2.3.7.10 BMA 5 (WMUs 404, 406, and 408 and Peter Lougheed Provincial Park)

BMA 5 primarily includes areas of subalpine (57%), alpine (30%), montane (4%) habitats, with the northern portion including boreal foothills (9%) habitats. The dominant vegetation cover classes include coniferous (47%) and conifer-dominated mixed (9%) forest, and shrub-dominated grass/forb (8%). Approximately 32% of the area is classified as nonvegetated mineral. The primary activities include pasturing of livestock and recreational facilities, although some cultivation, clear-cutting, and oil and gas development occur in the area. Approximately 5% of the land surface has been disturbed (Table 17).

BMA 5 provided 2% (11 bears) of the total 1972-87 provincial kill or 0.7 bears/year (Table 17), with the greatest proportion of those (73%) killed in WMU 404. The hunting season was closed in this area after the spring of 1969, and subsequently reopened on a limited-entry basis in spring 1987. Kills were infrequent in this area, with only one recorded kill made during 1982-86 (Figure 46). The densities of 0-11 bears/1000 km^2 required to support annual TKMMs during 1972-87 were below those of 12.2-14.5 bears/1000 km^2 reported for the area (Carr 1989) (Table 27, Figure 47). Although only nine bears were killed in this area during 1972-87, six or 67% were females (Table 28).

The estimated total population is 46 bears (Table 18). The estimated average annual total kill (0.3 bears), legal harvest (0 bears), and net removals (0.2 bears) was below the estimated annual allowable total kill

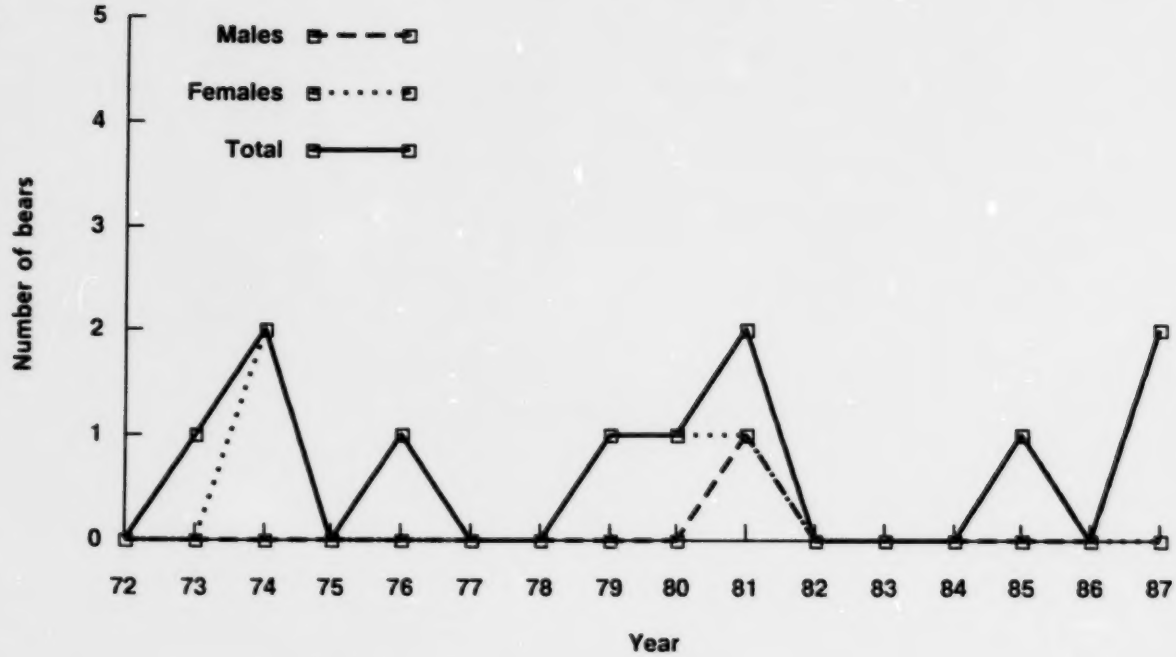

Figure 46. Annual total kill of grizzly bears in Bear Management Area (BMA) 5, 1972-87.

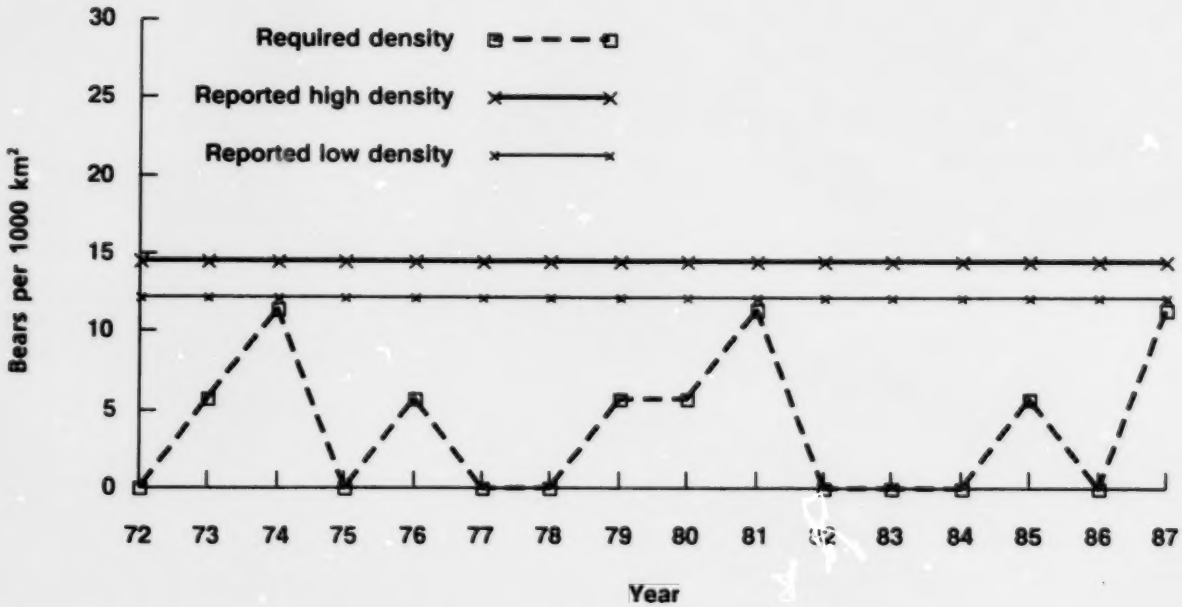

Figure 47. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 5 during 1972-87 and those densities reported for ecologically similar areas.

Table 27. Summary of mortality data for Bear Management Area 5.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
female	0	0	2	0	0	0	0	1	1	1	0	0	0	1	0	0
total	0	1	2	0	1	0	0	1	1	2	0	0	0	1	0	2
required density[a]	0	6	11	0	6	0	0	6	6	11	0	0	0	6	0	11
cumulative kill:																
female	0	0	2	2	2	2	2	3	4	5	5	5	5	6	6	6
male	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	3
percent female	-	-	100	100	100	100	100	100	100	83	83	83	83	86	86	67
CFMI[b]	0	0	1	1	1	1	1	2	3	3	3	3	3	4	4	3

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

(2.8 bears) and legal harvest (1.8 bears) (Table 18). This is largely an unexploited population from the perspective of consumptive use.

2.3.7.11 BMA 6 (WMUs 400 and 402)

BMA 6 primarily includes subalpine (73%) and alpine (22%) habitats, with the eastern portion extending into montane (5%) habitats (Appendix IV). The dominant vegetation cover classes include coniferous (57%) and shrub-dominated grass/forb (15%). Approximately 24% of the area was classified as nonvegetated mineral. The primary activities in the area include clear-cutting, pasturing of livestock, oil and gas development, surface mining, and urban and recreational facilities. Approximately 10% of the land surface has been disturbed (Table 17).

BMA 6 provided 5% (31 bears) of the total 1972-87 provincial kill or 1.9 bears/year (Table 17), with the greatest proportion of those killed in WMU 400 (68%). Fifty-eight percent of the removals occurred during 1982-86. The legal hunting season was closed after the spring of 1969. Kills from before 1981 were infrequent. The legal hunting season reopened on a limited-entry basis during the spring of 1982. The annual number of bears killed during 1982-87 ranged from two to seven bears (Figure 48). Significantly, 50% of the bears removed during the latter period were kills related to non-legal harvest. The densities of 0-29 bears/1000 km^2 required to support annual TKMMs during 1972-87 were predominantly below those of 12.2-14.5 bears/1000 km^2 reported for an ecologically similar area (Carr 1988) (Table 28, Figure 49). During the period 1982-87, the required densities of 15-51 bears/1000 km^2 were up to 3.5 times greater than maximum reported densities. Although annual TKMMs were predominantly composed of males during 1972-87, the high densities of bears required to support annual mortalities suggests that removal rates were excessive to maintenance of stable resident populations in this area during 1982-87 (Table 28, Figure 49). Strong clustering of kill locations of males and females occurred in the southern half of the BMA (Figure 23).

The estimated total population for BMA 6 is 33 bears (Table 18). The estimated average annual total kill (4.5 bears), legal harvest (2.3 bears), and net removals (2.6 bears) during 1982-86 exceeded the estimated annual allowable total kill (2 bears), and legal harvest (1.1 bear) (Table 18).

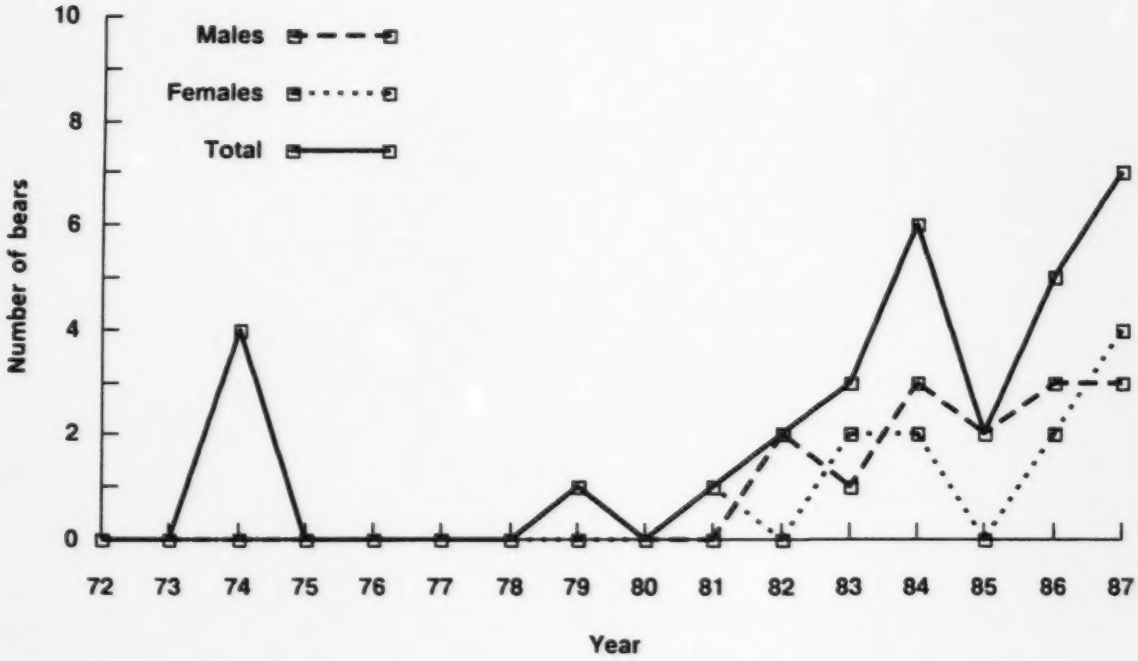

Figure 48. Annual total kill of grizzly bears in Bear Management Area (BMA) 6, 1972-87.

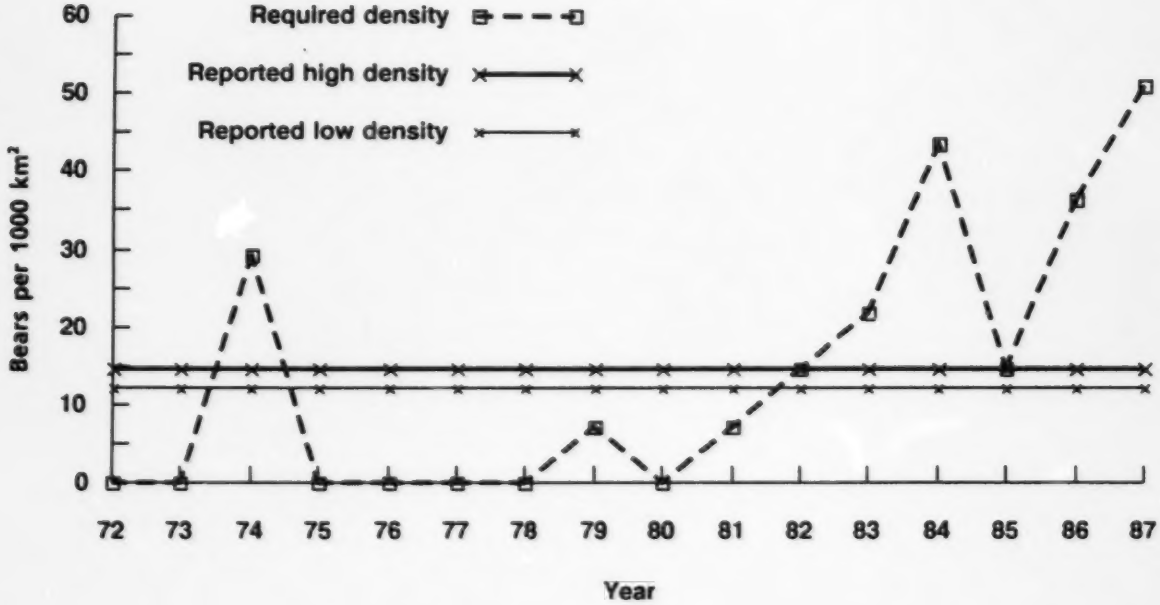

Figure 49. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 6 during 1972-87 and those densities reported for ecologically similar areas.

Table 28. Summary of mortality data for Bear Management Area 6.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	0	0	0	0	0	0	0	1	0	0	2	1	3	2	3	3
female	0	0	0	0	0	0	0	0	0	1	0	2	2	0	2	4
total	0	0	4	0	0	0	0	1	0	1	2	3	6	2	5	7
required density[a]	0	0	29	0	0	0	0	7	0	7	15	22	44	15	36	51
cumulative kill:																
female	0	0	0	0	0	0	0	0	0	1	1	3	5	5	7	11
male	0	0	0	0	0	0	0	1	1	1	3	4	8	10	13	16
percent female	-	-	-	-	-	-	-	0	0	50	25	43	38	33	35	41
CFMI[b]	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% female:65% males at P=0.10.

Bears were removed from the area at a rate which exceeded the sustainable level for a stable resident population. Removal rates have been sustained by immigration of bears from Waterton Lakes National Park, Glacier National Park, U.S.A. and southeastern British Columbia.

2.3.7.12 BMA 7 (WMUs 300, 302, 304, 305, 306, 308, 310, 312, 314)

BMA 7 includes areas of montane (40%), fescue grass (25%), boreal foothills (17%), mixed grass (7%), aspen parkland (7%), and subalpine (3%) habitats (Appendix IV). The dominant vegetation cover classes include conifer-dominated (18%) and deciduous-dominated (13%) forests, deciduous-dominated groveland (15%), shrub-dominated grass/forb (16%). Approximately 23% of the vegetative cover is cultivated. The primary development activities in the area include pasturing of livestock, cultivation, irrigation, with some clear-cutting oil and gas development, and urban and recreational facilities. Approximately 76% of the land surface has been disturbed (Table 17).

BMA 7 provided 5% (29) of the total 1972-87 provincial kill or 1.8 bears/year (Table 17), with the greatest proportion of those killed in WMU 300 (69%). Forty-eight percent of those bears were removed during 1982-86, with legal harvest constituting only 29% of the kills during the latter period. The greatest proportion of the bears in the total known kill were males (72%) (Figure 50). The annual TKMMs were extremely variable in this area, with most occurring during the period 1982-87. The densities of 12-24 bears/1000 km^2 required to support annual TKMMs during 1972-81 were predominantly higher than those of 12.2-14.5 bears/1000 km^2 reported for an ecologically similar area (Carr 1988) (Table 29, Figure 51). The high density of bears required to support annual TKMMs suggests that removal rates were excessive to maintenance of stable resident populations in this area during 1982-87. Kill locations were clustered along the eastern and northeastern boundaries of Waterton Lakes National Park (Figure 23).

The estimated total population is 12 bears (Table 17), with 8 of those considered to be seasonal immigrants. The estimated average annual total kill (4.0 bears), legal harvest (1 bear), and net removals (6.6 bears) during 1982-86 exceeded the estimated allowable annual total kill (0.7 bears) and legal harvest (0.3 bears) (Table 18). A total of 17 bears

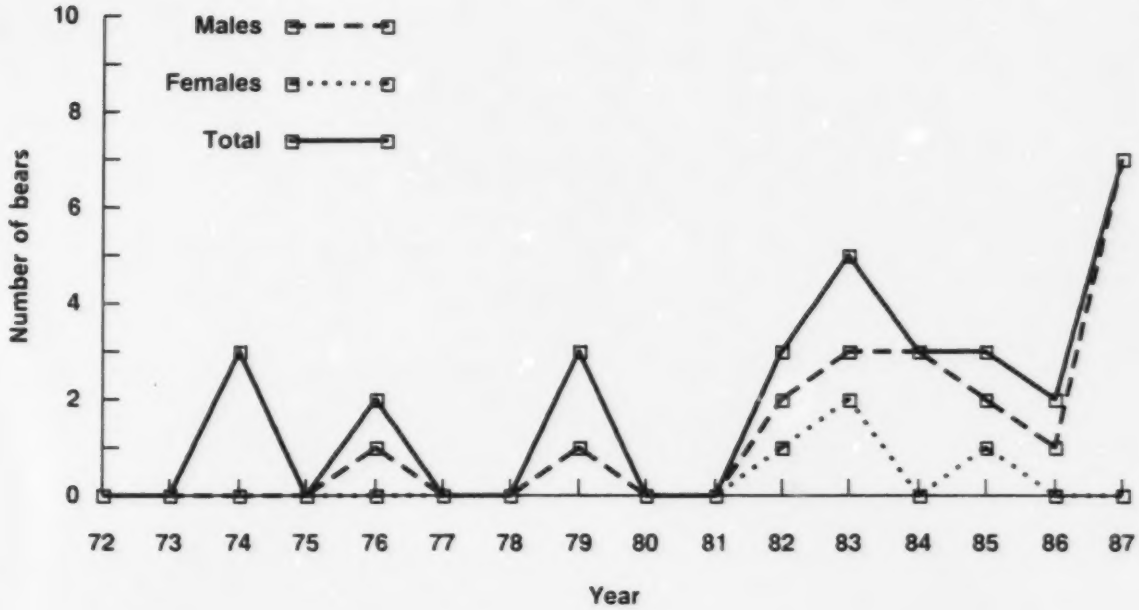

Figure 50. Annual total kill of grizzly bears in Bear Management Area (BMA) 7, 1972-87.

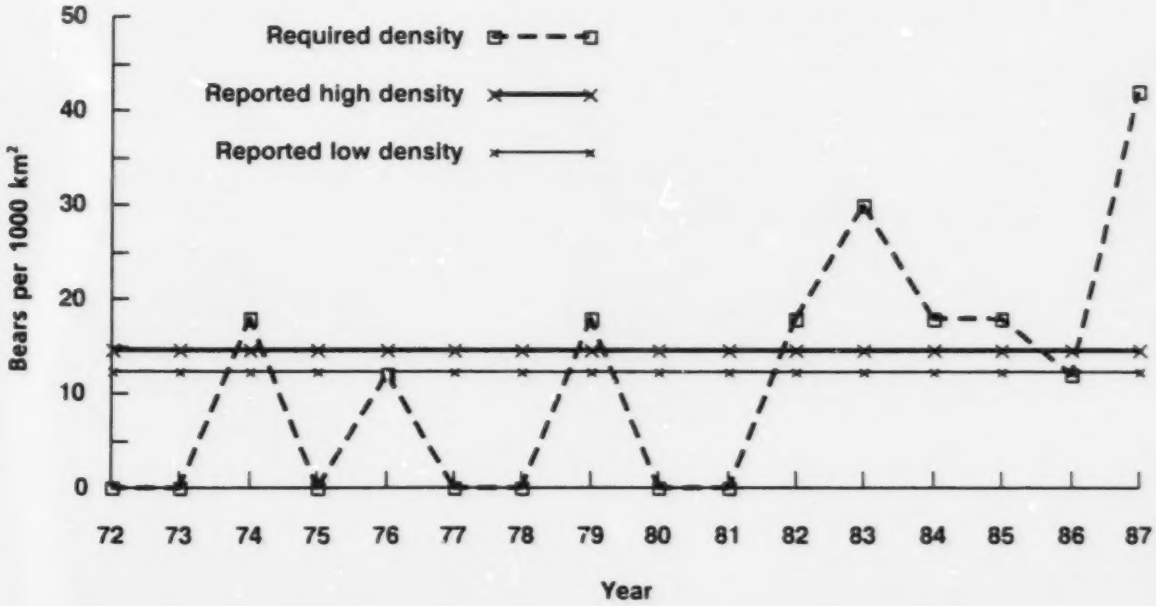

Figure 51. Densities of grizzly bears required to support annual total known man-caused mortalities (TKMMs) in Bear Management Area (BMA) 7 during 1972-87 and those densities reported for ecologically similar areas.

Table 29. Summary of mortality data for Bear Management Area 7.

	YEAR															
	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
known mortality:																
male	0	0	0	0	1	0	0	1	0	0	2	3	3	2	1	7
female	0	0	3	0	0	0	0	1	0	0	1	2	0	1	0	0
total	0	0	3	0	2	0	0	3	0	0	3	5	3	3	2	7
required density[a]	0	0	18	0	12	0	0	18	0	0	18	30	18	18	12	42
cumulative kill:																
female	0	0	3	3	3	3	3	5	5	5	6	8	8	9	9	9
male	0	0	0	0	2	2	2	4	4	4	6	9	12	14	16	23
percent female	-	-	100	100	60	60	60	56	56	56	50	47	40	39	36	28
CFMI[b]	0	0	2	2	1	1	1	2	2	2	2	2	1	1	0	-2

[a]Required density: density required to support annual mortalities assuming a maximum allowable man-caused mortality of 6%.

[b]CFMI: cumulative female mortality index. Values represent the difference between observed and expected removal of females to date assuming an acceptable ratio of 35% females: 65% males in the total kill. Positive values indicate more females were killed than expected, negative values that fewer females were killed than expected, and 0 values indicate that expected numbers of females were killed. The bar below the reported values indicates the years when the sex ratio of the cumulative kill deviated significantly from 35% females:65% males at P=0.10.

(10 males, 6 females, and 1 unknown sex) were translocated from this area during 1982-86.

BMA 7 does not support a substantial resident population because of the existing land developments and activities. Bears occurring in this area are considered to be immigrants that either migrate to use available seasonal ranges/habitats or are dispersing from populations in adjacent areas (e.g. southeastern B.C., Glacier National Park).

2.4 Summary

An estimated 154 034 km^2 of undeveloped or undisturbed lands occur within the current areas occupied by grizzly bears in the province (Table 30). These areas include the following: primary ranges (78% of area or 120 142 km^2) where substantial numbers of resident grizzly bears can be maintained in the future through intensive management and conservation programs; and, secondary ranges (22% of area or 33 892 km^2) which may be seasonally important to some bear populations, but existing land use activities preclude these areas from supporting substantial resident grizzly bears. Three primary ranges were identified including the northwestern (BMA 1), west-central (BMAs 2B, 3A, 3B, 4A, 4B, 4C, 16 and the White Goat, Siffleur, and Ghost River Wilderness Areas), and southwestern Alberta (BMAs 5, 6 and 15-WMU 410 and Peter Lougheed Provincial Park). Secondary ranges include BMAs 2A, 7 and 13. Approximately 96% of the estimated current resident grizzly bear population occupies areas within primary ranges.

The estimated current (1988) resident population on provincial lands in Alberta stands at 519 bears, with the total provincial population including that of the national parks estimated at 790 bears. The province must undertake intensive grizzly bear management and conservation programs to achieve a provincial population goal of 1000 grizzly bears (see Section 3.2.1).

In the following sections, the current status of grizzly bears on primary and secondary ranges in Alberta are reviewed. Table 30 provides a summary of estimates of areas of undisturbed lands in each BMA, estimates of supportable grizzly bear densities (number of bears/1000 km^2) and populations (derived by extrapolating supportable densities over existing undisturbed lands), and estimates of the potential for increasing population

Table 30. Estimates of supportable grizzly bear populations in Alberta (excluding national parks).

BMA[a]	PROPOSED[b] DENSITY (BEARS/ 1000 KM^2)	ESTIMATED PERCENT OF LAND SURFACE DISTURBED	ESTIMATED[c] AREA OF UNDISTURBED LAND (KM^2)	ESTIMATED[d] SUPPORTABLE POPULATION	ESTIMATED[e] CURRENT RESIDENT POPULATION	ESTIMATED POTENTIAL FOR INCREASE (BEARS)
PRIMARY RANGES						
1) Northwestern Alberta						
1	4	0.07	31 263	125	81	44
2) West-central Alberta						
2B	7.4	0.13	22 441	166	127	39
3A	7.4	0.15	20 882	155	79	76
3B	4.2	0.24	9 612	40	25	15
4A	10.0	0.11	9 222	92	41	51
4B	10.0	0.04	5 847	58	28	30
4C	12.4	0.07	5 448	67	32	35
16	4.0	0.14	8 150	33	8	25
GRW	10.0	0.00	177	2	2	0
SFW	10.0	0.00	443	4	4	0
WGW	10.0	0.00	487	5	5	0
Subtotal			82 709	622	351	271
3) Southwestern Alberta						
5	14.5	0.15	2 941	43	34	9
6	14.5	0.10	2 300	33	25	8
410	10.0	0.22	487	4	3	1
PLP	10.0	0.20	442	4	3	1
Subtotal			6 170	84	65	19
SECONDARY RANGES (DEVELOPED AREAS)						
2A	1.8	0.47	17 591	32	18	14
7	1.3	0.76	2 791	4	4	0
13	0.0	0.41	13 510	0	0	0
Subtotal			33 892	36	22	14
PROVINCIAL SUMMARY						
Primary range			120 142	831	497	334
Secondary range			33 892	36	22	14
All ranges			154 034	867	519	348

[a]BMA - Bear Management Area
[b]Proposed density of XX bears/1000 km^2 - Areas of undisturbed habitat will be managed to allow for the recovery of populations to these densities.
[c]Estimated areas of occupied land - Area of undisturbed or undeveloped land in each BMA.
[d]Estimated supportable population - Estimated number of bears that can be supported on existing undisturbed or undeveloped land in each BMA.
[e]Estimated current resident population - Derived from Table 17 and Appendix VI-1.

numbers in each BMA. Supportable population numbers were estimated in the context of existing land use activities and estimates of current habitat conditions. As a result, supportable populations may be increased in some areas if intensive habitat retention and improvement programs are employed in combination with grizzly bear management and conservation programs. General recommendations are given to achieve recovery of populations.

2.4.1 Northwestern Alberta (BMA 1)

Approximately 5% of provincial TKMMs (total known man-caused mortalities) were recorded in northwestern Alberta during 1972-87. Although legal harvest was the primary cause of deaths (76% of area mortalities), non-harvest related mortalities were significant factors contributing to losses of grizzly bears. No translocations were initiated in this area during 1974-87. Four percent of the provincial total personal or property damage complaints were recorded in this area during 1980-86. Complaints were primarily non-livestock/agriculture-related (95% of total for area). The densities of bears required to support annual TKMMs, the CFMIs, the distribution of kill locations, and estimates of kill status suggest that mortalities have occurred at allowable rates sufficient to maintain stable resident populations in northwestern Alberta.

Northwestern Alberta provides approximately 26% of the current primary ranges available to grizzly bears (approximately 31 263 km^2). This range supports about 16% of the estimated provincial resident population. The current resident population (estimated at 81 bears) could be increased by about 54% to around 125 bears through controlling legal harvest, by reducing non-harvest related mortalities through educational and preventive programs, and habitat enhancement and retention programs. Studies directed at determining the relative abundance of bears are required because little is known about grizzly bear populations in this region.

2.4.2 West-central Alberta (BMAs 2B, 3A, 3B, 4A, 4B, 4C, 16 and the White Goat, Siffleur, and Ghost River Wilderness Areas)

The greatest proportion of provincial TKMMs (79%) were recorded in west-central Alberta during 1972-87. Although legal harvest was the primary

cause of deaths (75% of area mortalities), non-harvest related mortalities were significant factors contributing to losses of bears. One-third (32% or 22 bears) of all translocations in the province during 1974-87 were initiated in this area. In addition, 39% of the provincial total for personal or property damage complaints were recorded in this area during 1980-86. Complaints were primarily non-livestock/agriculture-related (95% of total for area).

The densities of bears required to support annual TKMMs, the CFMIs, the distribution of kill locations, and estimates of kill status suggest that mortality rates in BMAs 2B, 4A, 4B and 4C have exceeded allowable levels to maintain stable resident populations during recent years. The population in BMA 3A may have been harvested at maximum rates since at least 1972. Mortalities in BMA 3B appear to have occurred at sustainable rates; however, no female grizzly bears have been killed in this area during the last 16 years. Only four bears (all subadults) were translocated from this area during 1974-87 (two in 1975 and two in 1987). In view of the fact that approximately 24% of BMA 3B supports intensive land use activities, the low incidence of past mortalities, translocations, and personal or property damage complaints suggests that this area no longer supports a significant resident breeding population. Although past removals in west-central Alberta may have been supported by immigration of bears from Banff and Jasper national parks and British Columbia, mortality rates appear to have largely exceeded the allowable levels consistent with maintenance of stable resident populations in this, the major area for grizzly bear production in the province.

West-central Alberta provides about 69% of the current primary ranges available to grizzly bears (83 709 km^2). The area supports approximately 68% of the estimated current resident provincial grizzly bear population. The estimated current resident population (351 bears) could be increased by about 77% to around 622 bears. This may be accomplished by controlling legal harvest, establishing habitat enhancement and retention programs, reducing non-harvest related mortalities through educational and preventive programs that aim to reduce bear-man conflicts, by supporting hunter education programs to reduce illegal and self-defense kills, by eliminating open pit garbage dumps in occupied habitats, and by establishing programs to reduce conflicts between grizzly bears and cattlemen and recreationists.

Studies directed at determining the relative abundance and population characteristics of bears in BMA 4A, 4B and 4C are required to determine the effects of past harvest rates. This area provides the greatest opportunity to increase grizzly bear populations in Alberta through intensive management and conservation programs.

2.4.3 Southwestern Alberta (BMAs 5, 6, 15-WMU 410 and Peter Lougheed Provincial Park)

Approximately 7% of provincial TKMMs were recorded in southwestern Alberta during 1972-87. Non-harvest related mortalities (70% of TKMMs for this region) including illegal (28% of area total) and self-defense kills (26% of area total) were the primary factors contributing to losses of bears. Twenty-six percent of the bears killed in the area were removed through legal harvest. Only 6% (four bears) of all translocations in the province during 1974-87 were initiated in this area. In addition, 27% of the total provincial personal or property damage complaints were recorded in this area during 1980-86. Complaints were primarily non-livestock/agriculture related (97% of total for area).

The bear population in BMA 5 has been largely unexploited since 1969 when the area was closed to hunting of grizzly bears after the spring hunting season. A limited-entry hunt, in which one grizzly was harvested, was held during spring 1987. Non-harvest mortalities have been uncommon here. BMA 6 was closed to hunting of grizzly bears after the spring 1969 hunting season and subsequently reopened on a limited-entry basis during the spring of 1982. The high densities of bears required to support annual TKMMs in BMA 6 suggest that removal rates exceeded allowable levels to maintain stable resident populations. Populations in BMA 5 and 6 are considered to be significantly influenced by dispersal of bears from populations in British Columbia, Waterton Lakes National Park and Montana. In view of the fact that 16% of the non-harvest related mortalities recorded in the province during 1972-87 and 27% percent of the personal or property damage complaints recorded during 1980-86 occurred in this region, significant changes in land use practices or management, and in human behavior, are required to reduce bear-man conflicts.

Southwestern Alberta provides approximately 5% of the current primary

ranges available to grizzly bears (6170 km^2). The area supports approximately 13% of the estimated current resident provincial grizzly bear population. The estimated current resident population (62 bears) could be increased by about 29% to around 80 bears primarily by establishing habitat enhancement and retention programs, reducing non-harvest related mortalities through educational and preventive programs that aim to reduce bear-man conflicts, supporting hunter education programs which seek to reduce illegal and self-defense kills, eliminating open pit garbage dumps in occupied habitats, and establishing programs on how to reduce conflicts between grizzly bears and cattlemen and recreationists. Studies are required, which are directed at determining the relative abundance and population characteristics of bears in BMA 6 and determining the effect of removals (kills and translocations) on the provincial estimates and numbers of grizzlies in Waterton Lakes National Park, British Columbia and Montana.

2.4.4 Secondary Ranges (BMAs 2A, 7, and 13)

Approximately 9% of provincial TKMMs were recorded on secondary ranges in Alberta during 1972-87. Mortalities unrelated to harvest amounted to 71% of the TKMMs for this region, including illegal (21% of area total) and problem wildlife kills (34% of area total), and thus were the primary factors contributing to losses of bears. Twenty-nine percent of the bears killed on these areas were removed through legal harvest. The greatest proportion of all translocations (43 bears or 63% of total) in the province during 1974-87 were initiated in these areas. Of the translocations initiated on secondary ranges, 70% were in BMA 7 and 23% in BMA 2A. In addition, 25% of the total provincial personal or property damage complaints were recorded on these ranges during 1980-86. Complaints were primarily livestock- or agriculture-related (53% of total for area), with 57% of the total provincial livestock/agriculture related complaints recorded in BMA 7.

Populations in BMA 7 are considered to be significantly influenced by dispersal of bears from populations in Waterton Lakes National Park, British Columbia, and Montana, while in BMA 2A a similar influence comes from grizzlies dispersing from adjacent populations in Alberta and British Columbia. In view of the large number of non-harvest related mortalities,

translocations, and personal or property damage complaints recorded on secondary ranges, significant changes in land use practices and management, and in human behavior, are required to reduce mortalities and bear-man conflicts. Of primary concern are the significant numbers of non-harvest related mortalities, translocations, and livestock- or agriculture-related personal or property damage complaints in BMA 7.

Secondary ranges provide approximately 33 892 km^2 of undisturbed or undeveloped lands available to grizzly bears. These areas support approximately 4% percent of the estimated current resident provincial grizzly bear population. The estimated current resident population (25 bears) could be increased by about 60% percent to around 40 bears. This may be accomplished by establishing habitat enhancement and retention programs, reducing non-harvest related mortalities through educational and preventive programs that aim to reduce bear-man conflicts, educating hunters to reduce illegal and self-defense kills, eliminating open pit garbage dumps in occupied habitats, establishing programs focused on reducing conflicts between grizzly bears and cattlemen and recreationists, establishing programs to deter or prevent illegal baiting and killing of bears in agricultural areas, and providing protection for bears during periods when habitats on secondary ranges are important to meet their seasonal requirements. Studies are required, which are directed at determining the relative abundance and population characteristics of bears in BMA 7 and determining the effect of removals (kills and translocations) on the provincial population and populations in Waterton Lakes National Park, British Columbia and Montana.

3.0 MANAGEMENT PLAN

3.1 Policy Framework

The Fish and Wildlife Policy for Alberta (Alberta Fish and Wildlife 1982) established policy goals for the administration of wildlife resources in Alberta. These policy goals, set out under five general categories, provide a framework for the formation of specific management goals for grizzly bears.

3.1.1 Resource Protection

"1) . . . The primary consideration of the Government is to ensure that wildlife populations are protected from severe decline and that viable populations are maintained . . . ."

3.1.2 Resource Allocation

"2)(a) . . . The wildlife resource, as a Crown resource, will be utilized in a manner which contributes the most benefit to the citizens of Alberta."

"2)(e) . . . Wildlife will be allocated through a defined process whereby specific resources are deployed to specified uses in order to achieve stated public benefits."

"11) The Division may allocate live wildlife for various uses such as game farming, game ranching, education or science and zoological displays, in conformity with other aspects of the Wildlife Policy."

"17) Wildlife must be allocated among different primary users in response to government policy. Until such time as supply and demand can be better rationalized, the following interim allocation guidelines will prevail in order of priority:

(b) Resident recreational use of game will have precedence over non-resident use. Wildlife stocks not fully allocated or utilized to higher priority uses may be allocated commercially to non-residents."

"18) The allocation of wildlife stocks to the different primary uses does not imply that other uses cannot occur within areas where such uses are entitled."

"22)(b)(ii)(a) ... Formally allocating wildlife to tourist lodge and/or outfitter use."

3.1.3 Recreational Use

"8) A variety of wildlife recreational opportunities, in addition to hunting, will be available for the benefit and enjoyment of Albertans."

"21) A variety of hunting opportunities will be available for the recreational benefit and enjoyment of Albertans. . . ."

3.1.4 Commercial Use

"22) The Division will encourage an environment that promotes the growth of the tourist industry . . . ."

"24) The Division will encourage an environment which fosters the development of a game ranching industry on private land and Metis Settlements . . . ."

3.1.5 Protection of Private Property

"4) The Government, through the Division, will assist in preventing or controlling wildlife from damaging property and endangering human life."

"5) Responsibility for damage in any form caused by wildlife will be shared in relationship to what people can reasonably do for themselves and to the amount of any additional damage beyond that which would normally be expected to occur in an area."

3.2 Management Goals And Objectives

3.2.1 Resource Protection

Goal: To ensure the provincial grizzly bear resource is protected from irreversible decline.

Objectives:

a) Increase the current grizzly bear population, estimated at 790 bears, to a population of 1000 grizzlies in Alberta (including national parks) through the application of conservative harvest management actions (the objective of 1000 grizzlies is within the range of the supportable grizzly bear population in Alberta, see Table 30).

b) Regulate man-caused mortality in each BMA so that it does not exceed 6% of the estimated populations, and that the sex ratio of the annual mortalities (total known man-caused mortalities) does not exceed 35% females.

3.2.2 Resource Allocation

Goal: To maximize benefits to Albertans through the optimum allocation of the grizzly bear resource amongst esthetic, recreational, commercial and other users.

Objectives:

a) Provide Albertans and visitors to Alberta the opportunity to view, photograph and otherwise enjoy the grizzly bear resource.

b) Provide the opportunity for recreational hunters to annually harvest up to 4% percent of the provincial grizzly bear population.

3.2.3 Recreational Use

Goal: To maximize the recreational benefits and enjoyment to Albertans from the grizzly bear resource through the provision of a variety of recreational opportunities.

Objectives:

a) Promote recreational uses such as observation and photography of grizzlies in their natural, undisturbed habitat.
b) Promote the recovery of grizzly bear populations to provide a sustainable annual provincial harvest of at least 25 bears (4% of populations in BMAs open to hunting, with the annual and cumulative harvest in each BMA not to exceed 35% females on a sustained basis, and a minimum of 750 grizzly bears on provincial lands by establishing conservative harvest rates, protecting and improving habitat, and educating the public to reduce non-harvest related mortalities.

3.2.4 Commercial Use

Goal: To maximize the commercial benefits to Albertans from the grizzly bear resource.

Objectives:

a) Provide opportunity for Albertans to benefit from the tourism value of grizzly bears.

3.2.5 Protection of Life and Property

Goal: To minimize property damage and other hazards to humans caused by grizzlies.

Objectives:

a) Reduce grizzly bear predation of livestock and pets through planned land management and agricultural development, and preventive livestock management.
b) Reduce the economic loss of grizzly bear predation to producers by continuing the Livestock Predator Compensation Program.
c) Remove offending grizzlies where required. In cases where grizzlies maul or kill livestock, capture and relocate offending grizzlies, where possible. In cases of maulings or serious threat to humans, offending grizzlies may be killed.
d) Reduce personal and property damage caused by improper storage and disposal of garbage and human foods through changes in garbage disposal management and public education programs.

3.2.6 Science and Education

Goal: To promote and encourage scientific and educational activity to enhance knowledge and appreciation of grizzlies.

Objectives:

a) Continue scientific research of grizzly bear populations and ecological requirements (e.g., habitat use and requirements).
b) Determine the effect of grizzly bear predation on selected ungulate populations.
c) Educate Albertans about grizzlies.

3.3 Management Strategies

3.3.1 Resource Protection

3.3.1.1 Habitat Management

The survival of the grizzly bear in Alberta primarily depends on preservation and management of habitat. Where grizzly populations transcend boundaries of management jurisdictions (e.g., Alberta/British Columbia, Alberta/U.S.A., Alberta/national parks), interagency cooperation is fundamental. An Alberta/Montana/British Columbia management team has planned grizzly management within and adjacent to southern Alberta since 1985. A key component of this cooperative project is the mapping of grizzly habitats in the border area (R. Demarchi, A. Dood, G. Erickson, pers. comm.).

Grizzly bear habitat management strategies, which include inventory, protection/retention, and enhancement programs, will be integrated among the administrative regions.

3.3.1.1.1 Inventory - The relative quality and availability of habitats in each WMU within the current occupied range of grizzly bears will be evaluated according to criteria agreed to by experienced grizzly bear biologists. Qualitative ratings of actual and potential habitat use will be based on field sign and on known grizzly bear habitat use and diet data extrapolated from various habitat studies conducted to date in Alberta [the Ministry of Environment and Parks, British Columbia is currently conducting this type of inventory program as an aid to managing grizzly bear populations in that province (R. Archibald pers. comm. 1988)]. This type of inventory would allow managers to provide better estimates of supportable grizzly bear populations, spatial distribution of critical or seasonally important habitats, spatial distribution of habitats which require protection, retention, or enhancement such as prime food-producing areas and nursery habitats, and the spatial distribution of habitats which require special management considerations relative to resource exploration, development and extraction activities.

Areas would be surveyed (see Herrero et al. 1986, McCrory et al. 1986, Wielgus 1986, Nagy 1988, Nagy in prep. for techniques) in the following order of priority:

1988-91 - BMA 4A (WMUs 430-446)
1989-92 - BMA 4C (WMUs 412-428)
1990-93 - BMA 6 (WMUs 400, 402)
1991-94 - BMAs 2 and 3
1994- remainder of range

<u>3.3.1.1.2 **Protection/Retention**</u> - The habitat retention program for grizzly bears will proceed as follows:

1) Establish and implement goals and management strategies for the protection/retention of habitats to support current populations and to allow the recovery of grizzly bears in areas where man-caused mortalities have been excessive. This will support the objective of achieving a provincial population goal of 1000 grizzly bears;
2) Integrate these habitat protection and retention objectives with current or proposed habitat management programs for other wildlife species and other uses of the land base; and
3) Establish and implement specific habitat management programs for public and private lands.

Integration will be accomplished through participation in regional and local planning, especially for public lands through integrated resource plans, river basin plans, etc. Integration of habitat retention goals on public lands occurs through participation in the government land use referral process. Referrals may result in a standard condition to protect habitat or individual recommendations for each referral regarding habitat retention during land use activities. Such activities are timber harvesting, agricultural expansion and intensification, oil and gas exploration and development, transmission line and transportation corridor development, recreation development, mining exploration and development, thermal power generation development, development of dams for flow

regulation and hydro power, and urban expansion.

Guidelines to maintain quality wildlife habitat generally involve restrictions on the type and level of use, and controls on public access to the site. The habitat under review may be flagged with a Fish and Wildlife reservation if it has not been previously identified in a planning document.

Protective measures used to provide security for ungulate habitat may be used to protect grizzly habitats. Such measures in use in Alberta include i) Forest Land Use Zones (FLUZ), ii) special areas with vehicular restrictions, iii) designated routes for vehicular use, iv) restrictions on road development and use, v) road reclamation, and vi) timber harvest.

<u>3.3.1.1.3 Enhancement</u> - Forest maturation can affect grizzlies in a negative way as is often the case with ungulates, especially elk. Effective fire suppression in the Eastern Slopes of Alberta has created a predominance of overmature (>120 years) and mature (81-120 years) forests (Alberta Forest Service 1985).

Productive wildlife populations can be maintained or enhanced by providing a diversity of habitats. Diverse habitats provide a variety of plant communities, each of which may be seasonally important in meeting a bear's total annual needs. Methods of habitat management that encourage forest diversity, include selective cutting, burning, seeding of forbs and planting of berry-producing plants. Timber harvests can be scheduled so that an area produces a sustained, even flow of grizzly bear foods within cutting units (Hillis 1986). Selective patch cutting, prescribed burning, seeding of graminoids and legumes and berry-producing shrubs have been used to improve grizzly habitats (Garcia 1986).

The Fish and Wildlife Division will lead planning with specific provincial forests (Alberta Forest Service) to develop regional objectives concerning retention and enhancement of grizzly bear habitats. Information pertaining to regional populations of grizzlies will be provided to forest planners to meet the local needs of the species. Prescribed burns will be incorporated in these forest/wildlife management plans.

Habitat enhancement for grizzlies in Alberta will be integrated with ongoing habitat enhancement programs for ungulates. Site selection will depend, in part, on the grizzly habitat inventory described above.

3.3.1.2 Population Management

3.3.1.2.1 Inventory - Long-term population census and/or monitoring studies are required in BMAs which are currently being harvested and in BMAs subjected to intensive resource development, agricultural and recreational activity. These studies would be directed to do the following:

1) Establish population estimates in BMAs where data are not currently available to effectively manage harvested populations,
2) Verify population estimates for BMAs where current estimates were derived by extrapolating densities reported for grizzly bears in ecologically similar areas, and
3) Monitor population trends in BMAs where intensive studies have been conducted.

See Harris (1986) for a review of optional techniques to monitor grizzly populations. The following two techniques are recommended for Alberta:

1) Live-capture, marking-release studies were recently conducted to derive population estimates for sites in west-central Alberta and Kananaskis Country (Nagy et al. 1989, Carr 1989). Although expensive, similar studies are required to obtain baseline data on population numbers, productivity, and habitat use where current data are inadequate or must be verified.
2) Establish a standardized, integrated, centralized observation reporting system of bear sightings with particular emphasis on a sow/cub registry. Employees of the Fish and Wildlife Division (biologists, wildlife officers, technicians, etc.), provincial parks (rangers, naturalists, backcountry maintenance workers, etc.), forestry (foresters, surveyors, towermen, etc.), and various industries (field personnel) working in

areas occupied by grizzly bears could participate in collection of sighting data. Public wildlife-interest groups (Alberta Fish and Game Association, Alberta Wilderness Association, etc.) could be requested to participate. To be of value, sightings must be verified to ensure authenticity and eliminate duplication. A system of verification must be in place before implementation of the reporting system. In addition to providing information on the reproductive success of females and a means of estimating population numbers (Eberhardt et al. 1986), this program would raise the public's perception of the grizzly bear resource. This system should be initially implemented in southern Alberta, through a toll-free phone system.

Priority areas for population census are the following:

1) BMA 4A (Willmore)
2) BMA 3A (Swan Hills - Berland River)
3) BMA 6 (Waterton - Castle River)
4) BMA 1 (Chinchaga drainage)
5) BMA 4C (Red Deer River)

3.3.1.2.2 Determination of Annual Mortality - The big game harvest compulsory registration program requires persons who harvest grizzlies to register their kill in person at a Fish and Wildlife office not later than 14 days after the close of the open season during which the animal was killed or 30 days after the date on which the animal was killed, whichever occurs first. Fish and Wildlife officers register all known grizzly bear mortalities regardless of cause of death. Continued collection of harvest, problem wildlife, illegal kill, self-defense, Treaty Indian, accidental, and research mortality statistics in a centralized data base is necessary. The date of kill, kill location, and sex and cemental age of each animal must be recorded. These data should be incorporated into and reviewed within the context of existing data bases, and analyzed on an annual basis.

The skull and skin, complete with evidence of sex attached, must be

submitted at registration. In the case of a female grizzly, a teat or a portion of the mammary gland must be attached to the skin.

Skulls from all grizzly bears dying in Alberta, whether originating from legal hunting, other hunting, protection of property, government or other source, must be donated or loaned to the Fish and Wildlife Division within 30 days of collection for a period of two months. During this period, a first premolar will be extracted for determination of age. Loaned skulls will be cleaned by the Division and returned to cooperating hunters.

<u>3.3.1.2.3 Control of Unlicenced Mortalities</u> - Non-sport hunting mortalities (illegal, problem wildlife, self-defense, accidental, etc.) constituted 32% of the total mortality during 1972-87. A major commitment must be made to change public attitudes toward grizzly bears in order to reduce this significant source of mortality. Positive attitudes, such as those expressed predominantly by park users toward grizzlies (IGBC 1987, Maw 1986), must be fostered among all users of natural resources and wildlands. Wildland users must be informed of the life history of grizzly bears, their behavior, and the ecological value of this large, rare species of bear through public education programs. Primary target audiences for education programs should include big game hunters and outfitters; farmers, ranchers, grazing lease managers, and recreational land owners; managers and field personnel working in industry, forestry, parks, and agriculture; and administrators and field personnel of municipalities that operate or allow open pit garbage dumps.

Big game hunters have killed a number of grizzly bears in self-defense while hunting other game species or while returning to ungulate carcasses claimed by bears. As a result, education programs should provide wildlife users with information on how to prevent, avoid, or reduce the potential for encounters, and how to recognize aggressive versus nonaggressive bear behaviors. Hunters must learn to back away from or avoid bears to reduce the need for self-defense actions. Systems such as electric fences at outfitter camps (see Bruns 1987) can be used to prevent problems.

Open pit garbage dumps within grizzly bear range have historically

become sites of chronic grizzly bear mortalities. Discussions will be initiated with the appropriate municipal governments regarding steps to reduce impacts on bear populations through improved garbage management where open pit dumps still exist.

The Division will assist land owners/users with the removal of dead stock from areas where incidents of personal and property damage chronically occur, such as on private and leased lands around Waterton Lakes National Park. This will reduce the potential for an unnatural transfer of grizzly bear resources onto private lands where they may be subject to problem wildlife control actions or illegal removal [Montana Fish and Game initiated this type of program in 1988 to remove winter-killed animals from grazing areas in grizzly bear habitats in northwestern Montana].

The Division will review the use of baits by land owners/users to control or hunt any predators/carnivores on private lands adjacent to national parks or other areas with important grizzly populations.

The Division will consider increasing deterrents for the illegal killing of grizzly bears on private lands.

Informational materials prepared and distributed in the past include the poster "You and bears: prevention of bear problems at industrial camps" for industrial camps operating in areas occupied by bears; and the brochures "Bear Facts" distributed in Kananaskis Park, "Bear Facts" distributed to the general public, and "Know your bears!" distributed to hunters. This program will be continued and expanded.

The Division will pursue the following priorities:

1) Continue the use of brochures, posters, pamphlets and other resource materials and provide them for distribution to target audiences.
2) Produce or promote the production of films/videos on grizzly bears that summarize pertinent information on their life history and behavior, and provide information on how wildland

users can minimize their impacts on grizzly bear populations. These materials should be promoted for public use and made available to wildland users, public conservation groups, wilderness associations, fish and game associations, and educational institutions.

3) Discourage illegal killing of grizzly bears and noncompliance with the compulsory harvest registration procedure, and encourage maximum penalties for illegal activities.
4) Encourage proper disposal of garbage in areas occupied by grizzly bears.
5) Encourage the use of electric fencing or other deterrents at backcountry outfitter and trailrider campsites.

<u>3.3.1.2.4 Translocation</u> - The program of translocation of nuisance bears (Section 2.3.2.5) should continue for most problem situations in Alberta. In general, translocation is recommended to eliminate the problem, encourage a change in behavior of the offending bear and supplement populations elsewhere. Nuisance grizzlies should be released as close as possible to their original range and habitat, but sufficiently far to reduce the possibilities of rapid return. In Alberta, this generally means translocating in excess of 200 km.

Special action is necessary to support translocation operations. Improved transport and release cages should be constructed and large helicopters rented so that family groups can be translocated to remote and inaccessible sites more efficiently.

Wildlife officers and biologists should determine the sex of the bear, extract a premolar tooth for aging, ear-tag, and tattoo the bear on the lip and groin before it is translocated. Ear marking and tatooing is essential to determine the effectiveness of the translocation. In addition, some bears should be radio-collared and monitored to determine the success of translocations.

Grizzly bears may be accepted from federal, provincial and state agencies provided the following hold true:

i) designated release areas with low or nil grizzly populations were available,
ii) maximum translocation of 500 km,
iii) most of the cost of capture and transportation must be borne by the donor agency, and
iv) history of individual bears must be reviewed.

Based on the summary of translocations (Section 2.3.2.5) and current population information (Table 17), priority release areas during 1989-91 should be as follows:

i) BMA 4A - Willmore
ii) BMA 2B - Kakwa, Simonette River and WMU 356

3.3.2 Allocation

Because of the growing demand for viewing and other nonconsumptive enjoyment of wildlife, certain grizzly bear populations should be managed with this as the priority or only use. Grizzlies in national parks and provincial wilderness areas are protected from hunting. Recreational hunting of grizzlies will be restricted or prohibited where nonconsumptive demands are high, e.g., Kananaskis Country.

Annual removal of the grizzly bear resource will be allocated as follows:

a) recreational hunting by resident Albertans...maximum of 4% of provincial population (calculated on BMA basis).

b) other benefits (Treaty Indians, scientific, etc.) must be included in the maximum annual man-caused mortality limit of 6% of provincial population.

Additional philosophies of allocation relative to recreational hunting are the following:

a) nonconsumptive use of grizzly bears should not be significantly limited by recreational hunting,

b) harvest of grizzly bears should be restricted on the basis of a lifetime maximum for licenced recreational hunters, and

c) some harvest of grizzly bears by nonresidents is permissible where/when reasonable success by resident hunters is achieved.

3.3.3 Nonconsumptive Use Management

The Division will promote public viewing and appreciation of grizzly bears. Primary viewing opportunities will be identified during the bears' active period (April through November). Public awareness and enjoyment of grizzly bears will be increased by doing the following:

1) Promoting the recovery of grizzly bear populations as outlined in this plan;
2) Maintaining the security of grizzly bear populations in national parks, wilderness areas, provincial parks, and other areas of special interest to grizzly bear viewing or appreciation by enthusiasts, e.g., Kananaskis Country;
3) Encouraging the development of a system of hiker trails or observation points from which the public can view grizzly bears in safety; and
4) Enlisting public assistance in grizzly bear population monitoring programs and habitat enhancement projects.

3.3.3.1 Kananaskis Country

Kananaskis Country is a high profile recreation area near one of Alberta's two major urban population centres, Calgary. Having a population estimate of 50 grizzly bears, this area will require management that focuses on natural history as the priority. Management must be integrated with the appropriate agencies. Because of the high complaint rate for this BMA, bear-human interactions will require specific management.

3.3.4. Recreational Hunting Management

3.3.4.1 Harvest and Licencing System

In the short term (1988-early 1990s), opportunities for recreational hunting of grizzly bears will be limited. Hunting of grizzlies by nonresidents was phased out in 1988. During 1989- , residents will hunt grizzly bear only on a special licence. Hunters will be selected during a

draw on a limited-entry system, thereby ensuring equal chance to all applicants. Licences will be allocated on a WMU basis subject to conditions within each BMA open to hunting.

To ensure population recovery, the harvest goal during the short term will be 2% of the hunted population. Average annual harvest will approximate 10 grizzlies (population of 500 X 0.02). Upon recovery to 1000 grizzly bears in Alberta, recreational hunting harvest will be limited to 4% of hunted populations. Licence rates will be determined by the formula:

Number of licences = WMU/BMA population X 0.04/Expected Success
(e.g., Population of 100 grizzlies = 80 licences at 5% success).

3.3.4.2 Harvest Quotas

Harvest quotas will be regulated so that the annual total known man-caused mortality does not exceed 6% of the estimated population in each BMA, and that the proportion of females in the annual total known man-caused mortality for each BMA does not exceed 35%. The number of licences issued will be reduced when removal rates exceed 6% of the estimated population and/or when the proportion of females exceeds 35% of the annual total known man-caused mortality. In addition, harvest quotas will be regulated on a WMU basis to minimize the potential for a local overharvest of females. A harvestable surplus may not exist in some WMUs or BMAs if nonhunting mortalities are excessive.

At the end of each licence year the following evaluations will be undertaken before harvest quotas are established for the next licence year:

1) The annual total known man-caused mortality data will be evaluated for each BMA. Harvest quotas will be regulated so that the annual total known man-caused mortality does not exceed 6% of the estimated population in each BMA.
2) The proportional representation of females in the annual and cumulative total known kill will be evaluated for each BMA. Harvest quotas will be regulated so that females do not

represent more than 35% of the annual and cumulative total known mortality for each BMA.

3) The geographic distribution of all mortality sites will be plotted and compared to the distribution of kill sites for the previous five-year period. Primary emphasis will be placed on examining the location of female mortality sites to avoid a local overharvest of females. Some WMUs may not be eligible for licences if recent mortalities predominantly consisted of females.

Grizzly bears will not be subjected to recreational hunting in BMAs or management areas where the estimated population declines to below 25 bears, unless immigration and/or nuisance/problem rates are high. This is the minimum number of bears that could be harvested at a rate of 4% and yield one bear.

3.3.4.3 Recreational Hunting in Southern Alberta

3.3.4.3.1 Waterton Area (WMUs 300, 302 and 400) - The population estimate for the Waterton Units was considered to be a minimum of 23 grizzlies (Table 17). The number of grizzly bears using this area varies seasonally and annually depending on the availability of natural foods and rates of immigration from protected populations in Waterton Lakes and Glacier National Parks and high-density populations in southeastern British Columbia (McLellan 1984). The Waterton area is currently subjected to intensive agricultural, industrial, and recreational land uses, and, as a result, migrant bears are often involved in personal or property damage situations and must be removed through problem wildlife control actions (e.g. several ear-tagged and radio-collared grizzlies have been captured at problem sites). Recreational hunting should be continued to encourage wariness (Herrero 1985, Dood et al. 1986)and replace other common causes of mortality among bears (36 non-sport hunting mortalities in 16 years).

Hunting in these units will be controlled to produce an average annual harvest of 1.5 grizzlies subject to a maximum average annual mortality of one adult (>5 years) female grizzly over a five-year period.

The average annual harvest during the 1983-87 five-year period was 1.6 (range 0-3) and average mortality of adult female grizzlies was 0.8. When the five-year running average harvest is greater than 1.5 or the average adult female mortality is greater than one, the number of licences will be reduced to achieve the desired level of harvest/mortality.

In 1988 and 1989, the number of licences were reduced from 27 to 15 to 7. This allowed for the harvest of one bear if the average success remained at 5.8%, as recorded during 1982-87 (188 authorizations, 11 grizzlies). Actual grizzly bear harvests in 1988 and 1989 were three and one, respectively.

3.3.4.3.2 WMU 402 - The number of grizzly bears in WMU 402 is estimated at 17 (Appendix VI-1). Nonhunting mortalities are lower in WMU 402 than in the Waterton units; four in 16 years. Allowable annual man-caused mortality is 17 x 0.06 = 1 grizzly. Six grizzlies have been harvested by recreational hunters during seven open seasons, 1982-88 in WMU 402 (4.5% success, 132 authorizations). Harvest should be one grizzly every two years. The number of special licences would be about 10 per year.

3.3.4.3.3 Kananaskis Country (WMUs 404, 406 and 408) - As previously indicated Kananaskis Country will be managed for nonconsumptive use of the grizzly bear resource. Recreational hunting of this population will be considered if the occurrence of serious bear-human conflicts increases, but planning of human use and education will be the primary strategies to reduce problems.

3.3.4.4 Protection of Adult Females and Young

Non-hunting related adult female mortalities have been high in grizzly bear habitats that support intensive human use. Because grizzly bears have very low reproductive rates (produce an average of two young every three years), productive females will be protected from recreational hunting. In 1987-88, all adult females accompanied by young of any age were excluded from harvest. This harvest management strategy should be continued.

Young grizzlies also require maximum protection because natural mortality rates of cubs can be high (Section 2.2.5). The protection of cubs and yearling grizzlies should be continued.

3.3.4.5 Seasons

The recreational hunting of grizzly bears will be restricted to a spring season. A spring hunt reduces the potential for the hunting of grizzly bears over "legal baits" such as gut piles or ungulate carcasses that would be available during the fall big game hunting season. In addition, the spring hunt provides a high quality hunting experience for sportsmen interested in bears and bear hunting.

Because the greatest kill of females has occurred during the last two-quarters of May (Figure 26), the hunting season will be closed by 15 May in those BMAs where populations are declining or below the population objective.

3.3.4.6 Damage Control Hunts

The use of damage control hunts to harvest problem bears in some chronic problem areas, such as in southwestern Alberta, will be evaluated. Under conditions where problem bears are accessible and destined to be destroyed, a hunter selected through a special draw could be provided with the opportunity to hunt a problem bear for a trophy. This problem wildlife management technique is currently being employed on a limited scale by Montana Fish and Game (M. Madel pers. comm. 1988).

3.3.5 Commercial Use Management

3.3.5.1 Wilderness Outfitting

A professional wildlife outfitting industry that provides recreationists with guided backcountry trail rides and hikes to view, photograph, and learn about the life history of grizzly bears, as well as caters to hunters, will be promoted by government.

3.3.6 Protection of Life and Property

The Division will provide the following:

1) Information and advice to land owners/users on how to prevent or reduce the potential for grizzly damage,
2) A damage/dangerous bear control program where required, and
3) Financial compensation to reduce the economic impacts of damages caused by grizzly bears.

The Division will continue to train personnel responding to or verifying damage complaints so that they have the expertise to recognize the diagnostic characteristics of grizzly bear damage and predation. In-house training programs reduce the potential for misidentification of grizzlies as black bears.

3.3.6.1 Food and Garbage Management

Grizzly bears are opportunistic feeders, and human food and refuse serves as an attractant to bears (IGBC 1987, Herrero 1985). Success at obtaining food from backcountry recreational and industrial campsites, campgrounds, recreational facilities, outfitter camps, and cabins or summer homes alters bear behavior, often to the detriment of both grizzlies and humans (IGBC 1987). Mortalities caused by the attraction of grizzly bears to sources of human food and waste can be reduced through proper storage of foods and proper handling and disposal of garbage in bear habitats used by humans (IGBC 1987, Herrero 1985). A program to install facilities (platforms, other devices to hang or store food and other attractants out of reach of bears) at backcountry recreation sites will be developed by the Division in cooperation with the Alberta Forest Service and other land management agencies.

The Division will promote the distribution of informational materials outlined in Section 3.3.7.

3.3.6.2 Livestock Grazing

The grazing of domestic livestock in grizzly bear habitats creates the potential for conflict and ultimately affects grizzly populations. This potential must be recognized in the context of agricultural policies. The costs of predator damage prevention, control and compensation programs should be considered when the expansion of agriculture activities into forested areas is proposed.

Crown land areas with current chronic grizzly bear-cattle depredation problems will be identified. The Division will initiate discussions with the appropriate land management agencies and grazing disposition holders regarding management strategies to minimize bear-cattle conflicts. In addition to discussing improved husbandry techniques, such things as obligatory removal of carrion, as required by the Livestock Diseases Act, 1971, will be stressed.

3.3.6.3 Policies With Respect to Bear Control

Divisional policies on problem/nuisance bear actions on private lands were outlined in "Problem Wildlife Management in Alberta," 1973 and 1979 editions (Gurba and Neave 1979), and to a lesser extent in Horstman and Gunson (1983). The General Wildlife Regulations, AR 50/87, of the Wildlife Act (1984) provide the most recent legislation. Black bears can be hunted (other than with traps) on 1) private lands by the owner or occupant or persons authorized by them, and on 2) public lands leased for the grazing of livestock by the lessee or persons authorized by the lessee.

No such provision is provided for grizzly bears. Landowners and lessees must report grizzly bear damage to the Fish and Wildlife Division.

Upon confirmation of kills, maulings or threats to livestock, pets or humans, the Division will attempt to control human access, capture, and then either translocate (move) or kill the offending grizzly bear. Offending grizzlies are almost always moved, with the exception of individuals that have exhibited unusual aggression towards humans or

individuals that are very old and in poor condition (see Section 3.3.6.5 for more details).

On minimally supervised grazing leases in the "Green Area" (Public Lands General Classification Map - 1986), bear control is often expensive and time-consuming, and may or may not be carried out, depending on economic and logistical considerations. Damage caused by bears will be documented, as far as is possible, by Fish and Wildlife Division personnel for compensation.

3.3.6.4 Response to Dangerous Bears

Divisional policy and procedures concerning response to dangerous bears are provided in "Field Services Standards and Procedures Manual" (Policy, June 1985; Procedures, NW2-9). The dangerous bear policy and procedures were developed from the recommendations of a 1980-82 task force established to review the Division's capability to respond to bear/human incidents. The task force recommended the formation of specially trained and equipped response teams to effectively and safely locate, capture, remove and/or destroy dangerous bears.

Highlights of the dangerous bear policy and procedures are as follows (see Field Services Standards and Procedures Manual, NW2-9):

1) The Division will respond to serious incidents involving dangerous bears by assembling a Bear Response Team (BRT) which will be responsible to effect the necessary control,

2) A number of qualified BRT leaders will be identified,

3) The Division will maintain a number of Bear Response Equipment Kits (BREK) which will be stationed at various districts throughout the province.

The dangerous bear policy and procedures are aimed primarily at incidents involving human injury or death, but may be implemented when it is

deemed necessary in other situations. Wildlife officers are placed in a higher than normal level of risk while effecting control measures. In compliance with the policy and procedures, BREKs were provided at five strategic locations in the province in 1985. Additional BREKs will be provided as budgets allow.

3.3.6.5 Guidelines for Problem/Nuisance Grizzly Status and Control

A grizzly bear will be determined to be a problem or a nuisance if one of the following conditions apply:

1) PROBLEM: There is sound evidence that the bear has attacked/mauled human(s), presents a threat to human safety because it has been seriously wounded or has acted aggressively without provocation, or has attacked/mauled or is a threat to pets or livestock.

2) NUISANCE: The bear is habituated to and regularly uses unnatural food materials (such as garbage, pet and livestock foods) which have been reasonably secured from bears, repeatedly frequents high human use areas such as residence areas or campground, or feeds on agricultural crops.

Bears determined to be a problem or nuisance under one of the preceding conditions will be subject to the control actions outlined in Table 31. Information on black bears is provided for comparison.

3.3.6.6 Nuisance Bear Identification and Records

The BRT leader or responding wildlife officer will ensure that sex, estimated age, weight or chest girth measurement, and general condition of the bear is accurately recorded on a standardized data collection form provided on a tooth specimen envelope. These envelopes will be available in District offices and in each BREK. In addition, the BRT leader or responding officer will ensure that a premolar tooth is extracted for aging and that the bear is properly ear-tagged, and tattooed on the inside of the

Table 31. Guidelines for bear control action in Alberta.

Species	Type of Bear	South[a]				North		
		Offence						
		None	1st	2nd	3rd	None	1st	2nd
Grizzly Bear	Orphan/Lone Cub	Hold	Hold	----	----	as in South		
	Sow/Cub	Release	Move	Move	Hold Cub Kill Sow[b]	as in South		
	Ylng or Subadult	Release	Move	Move	Kill[b]	as in South		
	Prime Adults	Release	Move	Move	Kill[b]	as in South		
	Senile[c] Adults	Release	Kill[b/d]	----	----	as in South		
Black Bear	Orphan/Lone COY	Hold	Hold	----	----	as in South	Hold	----
	Sow/COY	Release	Move	Move	Hold COY Kill Sow[b]	as in South	Move	Kill[b]
	Ylng or Subadult	Release	Move	Kill[b]	----	as in South	Move	Kill[b]
	Prime Adults	Release	Move	Move	Kill[b]	as in South	Move	Kill[b]
	Senile[c] Adults	Release	Kill[b/d]	----	----	as in South	Kill[b]	----

[a] S/N boundary is southern boundary of Peace River and Northeast regions.
[b] Tooth/envelope must be collected/completed.
[c] Extreme tooth wear; poor physical condition.
[d] Skull must be collected.

Release - Non-target bears which have been incidentally captured during the course of a control action should be released in the same area but not necessarily at the capture site.

Move - Subadult (3, 4, 5 yr) and adult male (>5 yr) grizzlies will be moved more than 200 km, whenever possible, to one of the designated Grizzly Bear Release Areas. On first offence, subadult and adult females, yearling, and 2 yr old grizzlies will be moved as far from the problem site as possible, but released within the same or adjacent BMA where similar habitat occurs. Moves of less than 200 km may be necessary if release areas become overpopulated or logistical problems cannot be overcome (weather, no helicopter, premature bear recovery). Black bears will be moved over 80 km unless situations as above arise. PROBLEM bears that pose a threat to humanes (Section 3.3.6.4), regardless of sex/age, will be released in remote locations or killed depending on the nature and severity of the aggression.

Hold - Cubs of the year (COY) that cannot be relocated with their mother will be held in captivity, and wherever possible, provided to zoos and other such facilities.

Kill - When bears must be killed, it should be done as humanely and discreetly as possible.

lower lip and/or in the groin area. The Division will provide all equipment in the BREKs necessary for obtaining the required biological data.

3.3.6.7 Compensation

Alberta Agriculture provides compensation to livestock and poultry producers when the occurrence of direct or indirect predator damage is confirmed by an investigating officer [Agdex 684-9 (Hutchings 1986)]. The Livestock Predator Compensation Program (LPCP) was developed to reduce the financial impact of predator damage on producers by replacing livestock or poultry damaged or lost through predation. The onus of responsibility for minimizing predation still lies with the producer. To June 1990, rates of compensation were as follows (Agdex 684-9):

Confirmed Kill - where the investigator has direct evidence that livestock death resulted from predator activity.	Compensation Up to 80% of commercial value
Probable Kill - where predation is likely but the investigator does not have sufficient evidence to conclude that livestock death was a direct result of predator activity. This situation results when an animal cannot, for one reason or another, be confirmed as a predator kill, but is associated with such a kill in both time and location.	Compensation Up to 50% of commercial value
Missing Animals - when the disappearance of an animal is associated with confirmed kills by both time and location, OR	Compensation Up to 30% of commercial value
Missing Animals - same as above, but applicable to grazing reserves or leases, where an official third-party count of livestock was made prior to predation.	Compensation Up to 50% of commercial value

Changes to LPCP effective June 1990 include 1) 100% compensation on confirmed kills and 2) elimination of the "Missing Animals" categories. The government of Alberta will continue to provide compensation for livestock animals killed by grizzly bears.

3.3.7 Education and Science

Public awareness and appreciation of the grizzly resource will be increased by the following:

a) provision of written and video educational extension materials that describe the natural history of grizzly bears in Alberta,
b) development of a grizzly observation program, and
c) investigation of additional grizzly populations.

4.0 MANAGEMENT PLAN APPLICATION

4.1 Provincial Summary

The primary challenge of grizzly bear management in Alberta is to increase the provincial population to 1000 bears. This can be accomplished by reducing man-caused mortalities and by providing security for populations through habitat protection and enhancement. Secondary challenges in grizzly bear management in Alberta are to provide increased opportunity for Albertans to observe and enjoy the grizzly resource, continue recreational hunting, and maintain an effective response to grizzly-human conflicts.

The Alberta Fish and Wildlife Division, recreationists, resource developers, landowners and the general public must work together in a coordinated effort if the provincial population goal is to be achieved. An extensive program of conservation and management must be undertaken if grizzly bears are to survive in significant numbers in Alberta.

Legal harvest and other man-caused mortalities must be reduced. Conservative legal harvests should be maintained as additional inventories are conducted. Similarily, education programs and legislation are required to reduce non-sport hunting mortalitites that result from bear-man conflicts. Agricultural, recreational, and resource development activities on lands within and adjacent to occupied grizzly bear ranges must be tailored to reduce bear-man conflicts.

Habitat must be maintained to support existing grizzly bears and to allow for their recovery to meet provincial population goals. Critical or important habitats require identification and protection throughout the range of grizzly bears in the province. Habitat enhancement programs may be required in some areas. In addition, forestry, agriculture, resource exploration, and resource development activities should proceed in a manner that is sensitive to and compatible with the needs of grizzly bears and other wildlife.

Alberta shares a common grizzly bear resource with Waterton Lakes, Banff and Jasper national parks and British Columbia and Montana. As a result Alberta should coordinate their conservation and management efforts with wildlife agencies in those jurisdictions.

The Fish and Wildlife Division will ensure that regional grizzly bear

management is coordinated through a centralized office. The "team" of regional wildlife biologists, field service staff, and headquarters managers will ensure that grizzly bear management programs meet provincial as well as regional objectives. They will do the following:

a) Review the recommendations, outline a course of action, and establish a realistic time schedule to ensure that the objectives and concerns outlined in the grizzly bear management plan are addressed in a timely manner,
b) Ensure that mortality data are collected, analyzed, and evaluated on a yearly basis and used to provide a sound basis for provincial harvest strategies and quotas,
c) Coordinate and monitor progress of habitat evaluation, protection, and enhancement programs,
d) Coordinate public education programs, and
e) Identify specific research needs.

4.2 Regional Perspective

4.2.1 Southern Region

Management of grizzly bears in the Southern Region will be coordinated with agencies managing bears within the Northern Continental Divide Ecosystem (NCDE) in the USA, British Columbia, and national parks in Canada. The Alberta grizzly bear management "team" in cooperation with participating NCDE agencies, will review the grizzly bear mortalities and management problems that have occurred in the Southern Region in the context of populations within the NCDE. Future management goals and land use policies should reflect the need for the protection of grizzly bears identified through that process. A registry of sow/cub sightings will be established in BMAs 6 and 7.

Problem grizzlies in Southern Region should not be killed unless a serious threat to human safety has occurred. Every effort should be made to release nuisance grizzlies within the area.

4.2.2 Central Region

Central Region has few grizzlies. Wildlife officers in High River and Cochrane districts should be trained and experienced in responding to bear problems.

4.2.3 Eastern Slopes Region

Approximately 50% of grizzly bears on provincial lands in Alberta occur in the Eastern Slopes Region. The foothill and mountain habitats have intensive recreational activities. A priority for management here is habitat inventory, protection and enhancement. Population goals will be established by BMA and WMU considering results of grizzly habitat inventory. Integrated resource plans will provide specifics of regional population goals within the context of Resource Management Zones (Eastern Slopes Policy, 1984), especially Zone 1 (Prime Protection) and Zone 2 (Critical Wildlife). A registry of sow/cub sightings will be established for BMA 5. A program to identify and develop a grizzly observation hiking route will be developed. Recreational hunting harvests will be reduced in BMAs 3A, 3B, 4A, 4B and 4C.

4.2.4 Peace River Region

About 45% of Alberta's grizzlies on provincial lands occur over a large, diverse area in the Peace River Region. Included here are extensive, remote areas with low density grizzly populations and settled areas with high rates of grizzly immigration (e.g., WMU 357). Coordinated land management is required to plan land use, especially anticipated agricultural expansion such as grazing leases and allotments. Costs of bear damage control need to be considered in development plans. Recreational hunting of grizzlies was closed in Big Game Zone 16 beginning in 1989.

4.2.5 Northeast Region

Northeast Region has few grizzlies. Sightings of grizzlies should be catalogued.

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